MARCH, 1910. BOTANICAL SERIES. VOL. III, No. 2

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA

STUDIES IN INDIAN TOBACCOS

No. 2. THE TYPES OF NICOTIANA TABACUM, L

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AGRICULTURAL RESEARCH INSTITUTE, PUSA

PUBLISHED FOR

THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA

BY

THACKER, SPINK & CO., CALCUTTA

W. THACKER & CO., 2, CREED LANE, LONDON

CALCUTTA :

PRINTED BY THACKER, SPINK AND CO.

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I. INTRODUCTION.

Ordinary tobacco (*Nicotiana tabacum*, L.) is grown all over India and is apparently the only species cultivated in the Peninsula. In this, as in other countries, it forms the most important source of the tobacco of commerce.

In perhaps no other cultivated crop is the question of quality so important as in tobacco. The general opinion seems to be that with the exception of some of the crop grown for cigar-fillers in Madras, the quality of Indian tobacco is not high. Whether this is due to the varieties grown, to the methods of cultivation, to climate, soil and moisture conditions, to the curing or to a combination of these causes is not known with precision. Several attempts have been made in the past to improve the quality of Indian tobacco by the introduction of American and Sumatra varieties and by the employment of American curers, but up to the present no results have been obtained. This want of success seems to have been largely due to the failure on the part of the investigators to realise that the first condition of success in improving this or any other crop is a thorough study

in the first place of all the various aspects of tobacco-growing and manufacture in India.

The first step in the improvement of Indian tobaccos is necessarily the study of the various types at present cultivated in the country. The material for this work was obtained from a large growing collection of Indian tobaccos on the Púsa Farm in 1907. This collection was made in 1905 and our selections were taken from the second generation of Púsa grown plants. All the types both of *N. tabacum* and *N. rustica* were selected in 1907 and have been grown in pure culture in the Botanical area at Púsa for the last two seasons.

The objects of the work in progress at Púsa on Indian tobaccos are as follows :—

1. The study of the varietal characters and the amount of variation in the Indian types of tobacco.

2. The isolation and growth in pure culture of all the constant forms obtained and the determination of the best types in cultivation. By this means seed of definitely described types is now for the first time available for variety trials and also for hybridization work.

3. The introduction, acclimatisation and testing of tobaccos from other parts of the world.

4. The study of the inheritance of characters in tobacco and the production of new and improved types.

The present paper contains an account of the work so far done on *Nicotiana tabacum* with regard to (1) and (2). The stability of the type of tobacco, when introduced into new localities, has been dealt with and also the important results which follow from natural cross-fertilization in the field.

The methods of raising the experimental plants in the case of this species follow closely those already described in the case of *Nicotiana rustica*.[1] The seedlings of this species grow more slowly, are less robust and are established with greater difficulty than those of the yellow-flowered tobaccos.

1 Howard and Howard, *Memoirs of the Department of Agriculture in India* (*Botanical Series*), Vol. III, No. 1, 1909.

II. THE STABILITY OF THE TYPE.

"Improvements in methods of culture, curing and fermentation have resulted in the production of tobacco having an increased value, but the most important factor in the development of more valuable tobaccos has been the production of improved varieties by seed selection and breeding. The production of these improved varieties adapted to local soil and climatic conditions has made possible the rapid development of the industry and enabled the United States in a comparatively short time to rank as the foremost tobacco-producing country in the world." (A. D. Shamel and W. W. Cobey, *Tobacco breeding*, Bulletin No. 96, Bureau of Plant Industry, United States Department of Agriculture, 1907, p. 8.)

Perhaps, no other factor in the production of high grade tobacco is so important as uniformity in the crop both as regards growth, and also as regards the type of plant grown. Unless the crop ripens uniformly, the difficulties of harvesting and curing are increased while a crop made up of several types of plant, differing in the size, venation, shape and texture of the leaves, increases the cost of sorting out the various grades for market. The maintenance of the uniformity of any desirable type of tobacco is therefore a matter of prime importance.

While there is agreement on the question of the importance and desirability of maintaining the type, nevertheless there is a general idea in much of the literature on this crop, that the uniformity of the type is easily disturbed by the introduction of any particular kind into a new locality. The use of immature seed, the application of heavy dressings of farmyard manure and commercial fertilizers and a change of soil and climatic conditions, particularly the taking of tobacco seed from southern

or tropical conditions, to the north, are considered by Shamel and Cobey[1] to be some of the causes of variation in the tobacco plant. Killebrew and Myrick[2] consider that soil and climate are two causes constantly in operation in increasing the number or in modifying the character of existing varieties. Lock[3] states: "As the Havanna tobaccos command the highest prices, the cultivator nearly everywhere attempts to introduce and cultivate them. There is no great difficulty in raising plants of these varieties, but they speedily degenerate and form new varieties, if the climatic conditions, etc., are not favourable."

The growth of the collection of Indian tobaccos at Púsa in 1905 afforded us an admirable opportunity of studying the effect of a new locality on the various forms and also the effect of soil and manuring. If the types of tobacco easily change, some alteration should be manifest after four years in the case of forms collected from such widely different localities as Burma, Assam, Madras and the Punjab. If, as is sometimes thought, introduced tobaccos gradually assume the form of those ordinarily cultivated in the district, the process should by this time have manifested itself at Púsa. Observations on the various types and photographs of actual plants for several years have, on the other hand, clearly demonstrated the remarkable uniformity of the types from year to year even to fine shades of colour and small differences in the morphology of the leaves and flowers and in the earliness and general habit of the plant when raised from self-fertilized seed. The same applies to the various types of *Nicotiana rustica* which we have examined, when grown from self-fertilized seed. No tendency to break up has been noticed, the types breed true in the most remarkable manner and there is no evidence of any transition on the part of the introduced forms towards the coarse-leaved sorts cultivated in Bihár. Excessive amounts of nitrogenous manure and over-watering have a marked effect on the vigour and

1 Shamel & Cobey, *Bull.* 96, *Bureau of Plant Industry, U. S. Department of Agriculture* 1907, p 11.

2 Killebrew & Myrick, *Tobacco Leaf*, New York, 1900, p. 30.

3 Lock, *Tobacco growing, curing and manufacturing*, London 1903, p. 32.

coarseness of growth of the plants concerned, but this rankness has not been found to be transmitted in any degree to the succeeding crop raised under more normal conditions.

There appears to be a considerable confusion of ideas in much of the literature on this crop as to the effect of environment on the tobacco plant. That *free flowering* tobaccos, introduced into a new district almost always change in type and frequently approximate, after a few years, to the local sorts, has often been observed. The experience in America[1] and our own observations amply prove this. That the physical condition of the soil, cultivation, manuring and climate have the most marked effect on the quality of the cured leaves and their suitability for various purposes cannot be denied. These are principles well known to all tobacco growers. The conditions in Sumatra, for example, favour the production of the best wrapper leaves. Cuba is famous for the aroma and quality of its cigar tobacco, and the various types of tobacco soil in the United States are largely responsible for the various grades produced in that country.

A little consideration will show that in the various modifications to which the tobacco plant is subject, two widely different and distinct kinds of change are involved, namely, (1) changes in the morphological sense, giving rise to the breaking up of the type and the formation of an uneven stand due to the production of plants varying very considerably in the shape, venation and colour of the leaf, in habit and in earliness and lateness, and (2) changes in the size, quality, and texture of the leaves of any particular kind and their suitability for various purposes. As has been indicated, variations in both these directions are possible in introducing a tobacco into a new locality. It is necessary therefore to attempt to understand the causes which bring about the changes in the type itself and also in the quality of the type. As has already been stated, no changes in the uniformity of the type have been observed in the Indian tobaccos grown at Púsa when raised from self-fertilized seed. On the other hand, when the

[1] Shamel & Cobey, l. c.

types are allowed to flower and seed freely at Púsa, the uniformity of the type is soon lost and the crop consists of a mixture of very diverse forms. Our investigations show that in all cases so far examined such variation in the type is the result of one cause only, namely, natural cross-fertilization. If crossing is prevented and the various races are raised from self-fertilized seed, the inheritance of all the characters down to the most minute shades of difference is most marked. The observations and experiments at Púsa point to natural cross-fertilization being the sole cause of changes in the race in the morphological sense. Soil, climate, moisture and food materials, no doubt, influence the quality and suitability of the leaf for various purposes, but we have not found these causes lead to the breaking up of the type.

Most observers agree that natural cross-fertilization occurs in this species, but the extent to which it takes place when the types are grown next to next does not appear to be fully realised. The collection of Indian tobaccos made at Púsa in 1905 was grown for two years on the Púsa farm, and a few plants of each kind were allowed to flower freely in 1906 and again in 1907. In 1907, we selected all the different types in this collection, and saved the seed from each plant separately. The various sowings were made by us in the Botanical area at Púsa the same year and since that time all seeds used to propagate the cultures have been selfed and raised under bag. Opportunities for natural crossing were possible, therefore, at Púsa for two seasons only, and these opportunities were limited by the fact that but few plants of each kind were allowed to flower and the period of flowering of the various kinds did not in all cases overlap. In 1908, observations were made on the uniformity of the cultures raised from one parent plant, and any individuals which varied from the rest in the slightest degree were noted. In every case these aberrant plants were selfed and grown the next year when they gave rise to a large number of forms, often very diverse in habit and in leaves and which were obviously the products of natural cross-fertilization (Plate I). In over a hundred cultures of this species in 1908, about 20 per cent. of the rows contained aberrant plants,

THE PROGENY OF A SELF-FERTILIZED ABERRANT PLANT.
AN EXAMPLE OF THE RESULT OF NATURAL CROSS-PERTILIZATION.

PLATE I.

thus showing to what a great extent natural crossing is possible when the various kinds are grown in close proximity and allowed to flower freely. Some of the aberrant plants only differed very slightly from the rest of the culture and much care was necessary to distinguish them. Sometimes they appeared only a little more robust than the rest, but in the case of every plant which showed the slightest variation in 1908, its progeny, after bagging, gave rise to uneven cultures made up of many different types.

Too much emphasis cannot be laid on the difficulty of observing the first generation of a cross between two kinds of tobacco in the field. The differences between many tobacco types are exceedingly small and can only be detected with precision after considerable study of such types when grown side by side and allowed to flower. Crosses between types, unless they are very different, would not be easy to observe in the F_1 generation even in cultures from single plants. In the field, where the great majority of the plants are topped, these differences would, in all probability, be overlooked. In the second and succeeding generations, when splitting takes place, the various types resulting from crossing could for the first time be observed.

In great contrast to the variable character of the progeny of a selfed aberrant plant is the great uniformity of the produce obtained from the seed of an ordinary plant raised under bag. In Plate II some of these constant pure line cultures are shown. These cultures afford a means of observing the occurrence or otherwise of mutations and also of the amount of variation that occurs in the types of tobacco. No mutations have been observed and every case of variation from the type has so far been proved to be due to natural crossing. These cultures show the remarkable uniformity of the plants of any particular type both in the same year and also from year to year.

From the practical point of view the significance of natural cross-fertilization is very great. The desirable types of tobacco grown in any district or introduced from other places must be self-fertilized if the quality of the type is to be maintained. The seed sown must have been raised under bag. Where a large number of

kinds are grown at an experimental farm, the greatest care will have to be taken to keep the types pure and to prevent intercrossing. To what extent intercrossing takes place in the cultivators' fields is not known at present, but the matter is now being taken up.

III. CLASSIFICATION AND DESCRIPTION OF THE TYPES.

1. Morphological characters.

The Indian types of *Nicotiana tabacum* show a much greater range in their morphological characters than do the forms of *Nicotiana rustica*, described in a previous paper. In many cases the differences in habit and in leaves are most marked. On the other hand, some of the forms resemble each other very closely and can only be distinguished by small differences in the leaves. It is sometimes impossible to be sure from one season's crop whether the differences are sufficient to differentiate such forms into separate types. Further study has, however, generally shown both that such small differences are wonderfully constant, persisting from year to year (see types XLI and XLII), and also that small differences in leaf shape, etc., are often combined with small differences in the structure and mode of pollination of the flowers (see types III and IV). Great difficulty has been experienced in expressing in words the differences in the shape of the leaves, and this has been increased by the fact that the shape (generally due to a diminution in the width and size of the leaves) often changes considerably from the base of the plant upwards. It is hoped that the photographs will make up for any deficiency in the descriptions.

Habit.

The various Indian types of *Nicotiana tabacum* differ considerably in habit. These differences are caused mainly by the change in the length of the successive internodes of the plant. They are accentuated by differences in the number, position and size of the leaves and by the arrangement of the inflorescence.

It will be best to consider these points in the order of their economic importance :—

(1) *Differences in the lengths of the successive internodes.* As regards this point, the 51 types can be arranged in an almost perfect series, the two extremes being represented by types XIX and LI. In types such as XIX the internodes are exceedingly short and the large leaves are borne so low down that most of them lie on the ground. In other forms the lowest internodes are short, but the succeeding internodes elongate gradually. In such cases many of the large leaves are borne near the ground, but a few moderate-sized ones are borne up the stem (see types V, X, XI, and XII). The plants in group II, class B, (b) (types XXXI, XXXII, XXXIII, and others) deserve special mention, for although they fall into this habit class, in their case the very short lower internodes are followed immediately by very long internodes, and this gives the group a characteristic appearance. Following on the cases in which the lowest internodes are short and the upper ones elongate gradually, we come to forms in which all the internodes are of equal length and the leaves are therefore borne at regular intervals up the stem. In such forms the only leaves lying on the ground are the two or three earliest formed leaves which are generally slightly different in shape to the rest. Good examples of this are types XVII, XLIII, and LI. The height of the plants is closely connected with the length of the internodes and varied in the 1909 crop from 78 cms. (type VII) to 188 cms. (type XXXIII). The actual height of a type in any year will, of course, vary with the conditions of nutrition and season.

The economic importance of the above differences in habit is very great, for in types such as XIX in which all the leaves are in contact with the soil for the whole or part of their length, the value of the cured product will be much depreciated by the dust and dirt which unavoidably clings to the leaves. Such leaves are also very liable to get damaged and torn, and surface cultivation is rendered difficult. In tall forms such as LI where the leaves are borne up the stem, the leaves are very liable to be torn by the wind,

especially in such localities in the plains where west winds or storms are prevalent while the tobacco crop is ripening.

(2) *Number, size and arrangement of the leaves.* Besides the differences in the position of the leaves just enumerated, the appearance of the plants is materially affected by the angle of insertion of the leaves. In some cases the leaves occupy a very upright position, the angle of insertion being small, as in type L; in others the leaves may be practically horizontal (type VIII), or they may bend over at various points, *i.e.*, at the base (type XVI), in the centre (type XXXII) or at the tip (type XXIII).

If the leaves are few in number, the plant has an open appearance (type XXIII), while numerous small leaves (type XLI) or a moderate number of large ones (type XXXIV) combined with a short habit give the plants a bushy appearance.

The economic importance of the size and number of the leaves is obvious.

(3) *Arrangement of the inflorescence.* The chief difference in the arrangement of the inflorescence which affects the appearance of the plant is the position of the former with regard to the leaves. In some forms the flowers are raised on long branches far above the leaves and in such cases the inflorescence is the most conspicuous part of the plant (see types IX, XI and XIX). In other cases the inflorescence does not grow out and the flowers are borne close to the large leaves (see types XXXV and XXXVIII), when the plants appear leafy.

The tendency to the production of side-shoots or suckers varies considerably among the various types. Some throw out few, others many and vigorous side-shoots. In order to allow the plants to manifest this tendency, only the suckers at the base were removed, the rest being allowed to develop. The habit photographs, therefore, show the tendency or otherwise of the types to sucker.

Leaves.

The angle of insertion of the leaves has already been discussed. In considering the leaves attention must be drawn

to the variation in the leaves on the same plant. The first formed leaves (2 or 3 in number) which remain on the ground, whatever the habit, generally do not possess the characteristic shape of the other leaves and must be left out of account. In some types all the remaining leaves, including the inflorescence leaves, are of the same form and only differ in size (types XVI, XLVIII and LI). In others the inflorescence leaves, generally linear, are quite different to the lower leaves, and there is in the latter a gradual change in shape and in the acuteness on the apex according to the position of the leaf of the stem—the upper ones being generally narrower with more acuminate apices than the lower ones (types XII and XIII). The variation is, however, gradual and one of degree only, *e.g.*, elliptical leaves tend to become lanceolate. In the descriptions such gradual changes have been indicated where possible and the photographs and measurements have been taken from the 4th, 5th and 6th leaves.

The leaves may be sessile or petiolate; in the latter case the petiole is invariably alate. The narrow strip of lamina forming the wings is generally very undulate and the width may vary with the position of the leaf on the plant. Thus, in type V the wings are so broad in the upper leaves as to make them appear almost sessile. In the majority of the types the leaves are amplexicaul and decurrent. The breadth of the decurrent strip of lamina and its length varies considerably in the various types, and the latter may be as much as 5 cms. (type LI). Many of the leaves are auriculate, the size of the auricles being characteristic of the type. In the general shape of the leaves the types fall into three classes: (1) those with lanceolate leaves having acuminate apices (types XI, XII and XIX), (2) those in which the leaves are broad in the centre and taper towards both the apex and the base (types XXXI and XXXII), (3) those in which the leaves are elliptical with acute or somewhat obtuse apices, the lamina being somewhat reduced at the base (type XLI, XLVIII and LI). Within each class considerable differences are found, especially in the amount by which the lamina at the base of the leaf is reduced (cf. types XXXVIII and LI).

Another difference which is of use in distinguishing the types is the angle at which the secondary veins arise; this varies from nearly 90° (type XLIV) to 30° (type VIII) and is constant for any one type. For cigar wrapper tobaccos the angle of venation is of great importance. The form of the apex is generally acute or acuminate, but every gradation is found between the almost obtuse apex of type XXXV to the long slender prolongation in type XIX. Very few of the leaves are quite smooth and flat. The margin may be entire or may be regularly and slightly undulate giving the leaves a "frilled" edge (type XXIV) or may be irregularly and more deeply undulate. Besides these sinuations of the margin the whole leaf has often deep, somewhat irregular undulations, especially near the base (type XIV). The surface may be flat or puckered to a varying extent, and the lamina is often raised between the secondary veins, giving the appearance of ridges or folds parallel to the secondary nerves (type XXXII). The flatness or otherwise of the leaf is an important point in determining the value of the cured tobacco for certain purposes and on the whole the Indian tobaccos are characterised by great unevenness of surface. Our experience at Púsa tends to show that the amount of undulation and puckering of the surface depends to some extent on the conditions of cultivation. Further experiments on this point are in progress. The colour and texture also show much greater differences than in *N. rustica;* type LI has the thinnest leaf, while types VI, VII and VIII are exceedingly thick and would probably be useful only for the manufacture of snuff. The length of the leaf varies from 25 cms. (type XLII) to 63 cms. (type VI), the ratio of length to breadth varies from 1·5 (type III) to 4·4 (type VIII). These measurements, taken on the 1909 crop, and also the notes on the texture are only of relative value.

Inflorescence.

The position of the inflorescence has already been discussed in considering the general habit of the plant. No such marked differences in the arrangement of the flowers is found as occurs

between the open and crowded inflorescences in *N. rustica*, but certain of the types are more free flowering than others. The tall types of group B are in general characterised by the paucity of their flowers, while some of the dwarf varieties produce a profusion of blossoms (type XIX). The general shape of the inflorescence depends on the mode of growth of the side branches. These, although always borne in basipetal succession on the main stem, may be short and originate mostly near the top (type LI) or may be very long and spreading (type XXIII), or if the internodes are very short, may all appear to spring from the base of the plant (type XIX). The inflorescence on the main axis always flowers first and the side branches in order from above downwards. The relative length of the side branches to the main axis varies considerably in the different types: (1) the side branches may be of such a length that when in bloom the flowers are at the same level as the flowers on the main axis, and in this case the inflorescence has a flat top (see types XVII and XIX); (2) the flowers on the side branches may be higher than those on the main axis (types XLI and XLII); or (3) the flowers on the side branches may be at different heights and at a lower level than the main axis when the inflorescence, as a whole, has a "pyramidal" appearance (types XV and XLVIII). These differences in the appearance of the inflorescence, although characteristic of the types, are often lost later on in the capsule stage by the development of further branches due to excessive watering or other conditions. They are best seen when the flowers on the side branches are just opening and the first capsules have been formed on the main axis. The habit photographs of the plants were, as far as possible, taken at this stage, and in all cases these as well as those of the leaves were taken at approximately uniform distances from the camera.

Flowers.

Although at first sight the flowers of *N. tabacum* appear very much alike, there are considerable differences in the details of structure of the calyx and corolla. Such differences occur in

every possible combination and in the 51 types described very few of the flowers are alike in every particular.

Unlike the types of *N. rustica* where the length of the flower was practically constant and only the width varied, the flowers of the types of *N. tabacum* show considerable differences in length. The shortest flowers are found in type IX where the length is 36 mm., the longest in type XI where the length is 50 mm. or more. The usual length of the flowers is about 45 mm. The colour is generally some shade of pink, but in some types the pink colour is confined to the extreme tips of the corolla lobes in the closed bud, the flower itself being quite white. In many cases the pink colour fades and the older flowers are almost or entirely white. In some types the pink colour is very deep and practically does not fade at all (types XXX, XXXII and XXXV).

Calyx. The relative length of the calyx and corolla varies, but the length of the calyx is always between one quarter to one half that of the corolla. The gamosepalous calyx is not markedly asymmetric and the teeth are generally somewhat long and acute. In shape the calyx is generally tubular but in a few types (*e.g.*, XXXVIII, LI and others) it is distinctly globular and inflated.

Corolla. Several differences in the form of the corolla may be noticed. The orifice varies in size from a diameter of 7 mm. (type I) to one of 11 mm. (type VII), but the usual width is 8 to 9 mm. The shape of the corolla (apart from the shape of the limb) depends on the width of the tube, on the width of the throat or dilated portion and on the manner of transition between these two. The tube may be of various widths from the slender tube in type XVI (Plate XVIII) to the broad tubes of types XXXVIII and XLVII (Plates XL and XLVIII). The tube may gradually dilate, giving the corolla a funnel-shaped appearance, or there may be a sudden expansion in which case the corolla appears "bell-shaped." Good examples of bell-shaped corollas are seen in plate XLVIII, types XLI and LI. The limb may be (1) quite entire when it assumes a pentagonal shape (type XXXVIII, Plate XL), (2) almost entire but slightly notched at the junction

o the lobes (type XLVIII, Plate XLVIII), (3) slightly divided (type XXXVII, Plate XL), (4) divided to about half its distance (type XXV, Plate XXIX), (5) deeply divided (type XVII, Plate XVIII). The undivided portion of the limb may be quite flat (type XXXVIII, Plate XL) or may form slight folds or ridges at the line of junction of the lobes (type XLVIII, Plate XLVIII). The shape of the lobes varies somewhat. They may be more or less triangular with somewhat straight margins (type XXXIX, Plate XL) or much rounded at the base (type XVII, Plate XXII). The apex may be acute or prolonged into a point (longer or shorter according to the type), which may be straight or oblique. A good example of such apical points is seen in type XVII (Plate XVIII), type XXXIV (Plate XL), and in type IX (Plate XII).

Capsule. The capsules in the Indian forms of *N. tabacum* vary in size, shape, nature of the apex and in the degree to which they are covered by the persistent calyx. The shape may be cylindrical or conical, the apex blunt or pointed. In some types the capsules have a tendency to fall off when ripe together with the peduncle instead of remaining *in situ* and shedding the seed by dehiscence. In such cases it is necessary to protect any crossed or selfed capsules by a bag just before they are quite ripe.

2. Modes of pollination.

The frequency of cross-pollination in *Nicotiana tabacum* has already been discussed on page 64. Knuth,[1] in his *Handbuch der Blütenbiologie*, drew attention to the fact that the arrangements for pollination differ somewhat in the various races. The pollination of all the Indian types of *Nicotiana tabacum* has been studied to obtain as much information on this point as possible. Of the five stamens, one is always much shorter than the others and is generally well below the stigma. In a few cases, however, it may be long enough for its tip to touch the stigma. The pollen of this stamen is, therefore, negligible for self-fertilization. The remaining four stamens may be approx-

[1] Knuth, *Handbuch der Blütenbiologie*, Bd. II, 1899.

imately equal in length, and this is the most usual arrangement, or one may be shorter than the other three, or there may be 2 long and 2 short stamens.

Pollination may take place in the closed bud or, as is more frequently the case, the anthers burst just as the bud unfolds. In a few cases the anthers burst later when the flower is half expanded. In the time of pollination this species differs from *Nicotiana rustica* in which pollination generally takes place just before the bud opens.

The relative position of the anthers and stigma and consequently the certainty of self-pollination varies in the different types. The anthers may be below the stigma when they burst and may remain always at a lower level than the stigma, making cross-pollination very probable, but this is rare. The most usual arrangement is that in which the ripe anthers surround or are just above the stigma when the flower opens. In the fully opened flowers the burst anthers and stigma may maintain this relative position or the anthers may be as much as 5mm. above the stigma. In some cases the ripe anthers are well above the stigma in the unfolding bud, and in such cases the burst anthers are always far above the stigma in the fully open flower. In one or two types, cases were found in which the ripe anthers surrounded the stigma, but the latter was well above the empty anthers later.

Another striking difference was observed in the position of the stigma and anthers with regard to the orifice of the corolla. In some cases the anthers or stigma project far beyond the corolla opening. This can be seen in the front view of the corolla of type II (Plate III) and of type IX (Plate XII). In other cases the anthers or stigma remain low down in the tube of the corolla. In the majority of the types, the anthers are either level with the corolla orifice or project slightly.

In the majority of the Indian types of N. *tabacum*, self-pollination is somewhat more favoured than cross-pollination, but in none of the types so far examined is crossing practically excluded as in type V of N. *rustica* where the stamens are massed so closely

over the stigma that the latter is never visible. The filaments of N. *tabacum* are much longer and the flowers are larger than in the case of the yellow-flowered tobaccos. In consequence the anthers do not fill up the throat so completely and are not in such close contact with and do not form a ring round the stigma as in the case N. *rustica*. Sometimes the anthers are on one side of the stigma only ; in other cases some are on one side and some on the other. These circumstances affect pollination considerably, and as the flowers lie more or less horizontally, a good deal of pollen is wasted and often falls on the inside of the throat of the corolla. The types in which the stigma is above the stamens never set seed when bagged and have to be selfed.

3. Scheme of classification.

A comprehensive phylogenetic and systematic study of the species *N. tabacum* was made by Comes[1] who collected a large number of the different forms from all parts of the world. From the results of this study he divided the species into six varieties, the distinction between them depending very largely on the shape of the leaves.

(1) var. *fruticosa* Hook.
(2) var. *lancifolia* (W.) Comes.
(3) var. *virginica* (Agdh.) Comes.
(4) var. *brasiliensis* Comes.
(5) var. *havanensis* (Lag.) Comes.
(6) var. *macrophylla* Schrank.

Of these he states that (3) and (4) are no longer to be found in a pure state, but only as hybrids with other varieties.

This subdivision of the species has been vigorously assailed by Anastasia[2], who reduces the number of varieties to four,

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[1] Comes, *Monographie du genre Nicotiana*, Naples, 1899 and *Delle razze dei Tabacchi*, Naples, 1905.

[2] Anastasia, *Le varieta tipiche della Nicotiana tabacum*, L., Scafati, 1907.

excluding var. *fruticosa* and var. *lancifolia* and substituting var. *purpurea* for var. *macrophylla*.

The varieties according to Anastasia are therefore as follows :—

var. *havanensis*.
var. *brasiliensis*.
var. *virginica*.
var. *purpurea*.

Recently Comes[1] has published a short answer to the criticisms of Anastasia.

Into the merits of this controversy it is impossible for us to enter as we have not at our disposal in India the material on which the rival systems are founded, and we have, therefore, been unable to make use of either. Moreover, the cultivated forms do not show the characters of any one of these "typical" varieties, but a combination of the characters of two or more. This is referred by Comes to the hybrid nature of the cultivated forms, and in his large work *Delle razze dei Tabacchi* (which is in the main a description of a large number of commercial forms of tobacco from all over the world) he classifies almost all the cultivated forms as hybrids between two or more varieties. Thus Cimanon tobacco from Mexico is classed as a hybrid of *fruticosa* × *brasiliensis* × *havanensis* × *macrophylla*, China tobacco as a hybrid of *fruticosa* × *brasiliensis* × *lancifolia*. Such a classification appears to be open to several objections. In the first place, it gives no handy and workable guide in identifying any particular form, and, secondly, in our present state of knowledge regarding the inheritance of characters in the species *N. tabacum* it is difficult to prognosticate what products such a hybridization of four quite different varieties would yield. It is certain both from theoretical considerations, and from the evidence already obtained from accidental cross-fertilization, that the number of forms obtained would be numerous It does not appear justifiable therefore to state that a form is a hybrid between

[1] Comes, *Bolletino Tecnico*, No. 1, Scafati, 1908.

two varieties, unless such has been proved to be the case by actual experiments. Under these circumstances we considered that it would be best to arrange the Indian tobaccos in a provisional scheme of classification based on easily recognizable characters to facilitate identification and reference. The choice of the characters on which to base the classification of the Indian forms of *Nicotiana tabacum* was difficult owing to the manner in which the types grade into one another and form a series. The most promising characters appeared to be habit, shape of the leaf and the similarity or dissimilarity of the inflorescence and lower leaves. It was finally decided to base the main divisions on the leaf characters, using the habit for further subdivisions.

Of the fifty-one Indian types of *N. tabacum*, five may be termed petiolate and are placed in one group. The petioles are always alate and the inflorescence leaves occasionally appear almost sessile, but there is no difficulty in separating the petiolate forms from the others. Only in the case of type VII it must be noted that a few of the median leaves appear stalked. In all the leaves the lamina is much reduced and in a few the reduction is carried so far that only a very narrow strip of lamina runs down the petiole. One of these has been chosen for the photograph. As, however, the sessile character of most of the leaves is clear, the occasional presence of the leaves in which a petiole is simulated should present no difficulty. Whether the leaves termed "petiolate" above should really be considered as leaves in which the lamina is reduced to a minimum does not concern the classification, as the stalked character of the leaves in these types forms an easy mark of distinction. The group of forms with sessile leaves is subdivided into three classes depending on the character of the leaves: (A) forms with long narrow leaves, (B) forms with leaves broad in the centre and tapering towards both ends, (C) forms with leaves broad and elliptical which do not taper at either end. These distinctions hold well on the whole, although both in (B) & (C) there are one or two types which are not absolutely typical (see type XXIII in (B) and type

XXXIV in (C)). These classes are further subdivided according to the habit.

I. Leaves petiolate.

A. Leaves ovate.

Types I, II.

B. Leaves subcordate.

Types III, IV, V.

II. Leaves sessile.

A. Lower leaves linear or lanceolate ; ratio length to breadth 3 to 4 ; inflorescence leaves linear.

(1). Leaves linear, very thick ; ratio length to breadth more than 4.

Types VI, VII, VIII.

(2). Leaves lanceolate, not very thick, ratio length to breadth between 3 and 4.

(*a*) Internodes short ; all the large leaves form a rosette on the ground.

Type IX.

(*b*) Lower internodes short, upper gradually lengthened ; many large leaves borne on the ground, a few continued up the stem.

Types X, XI, XII, XIII.

(*c*) All the internodes moderately long ; only 2 or 3 leaves on the ground.

Types XIV, XV, XVI, XVII, XVIII.

B. Lower leaves broad in the centre, tapering towards both ends ; ratio length to breadth between 2 & 3 ; inflorescence leaves linear or similar to, but narrower than, the lower leaves.

(1). Internodes short; all the large leaves form a rosette on the ground.

Type XIX.

(2). Lower internodes short, upper internodes moderately long; some large leaves on the ground, others on the stem; leaves numerous; plants bushy.

Types XX, XXI, XXII.

(3). Lower internodes short, upper internodes very long; most of the large leaves borne on the ground; plants tall; inflorescence open with few flowers.

Types XXIII, XXIV, XXV, XXVI, XXVII, XXVIII, XXIX, XXX, XXXI, XXXII, XXXIII.

C. Leaves elliptical, broad, apex acute; lamina at the base only slightly reduced; ratio length to breadth about 2; inflorescence leaves always similar to the lower leaves.

(1). Lower internodes short, upper internodes moderately long.

Types XXXIV, XXXV, XXXVI, XXXVII, XXXVIII, XXXIX, XL.

(2). All the internodes equal in length and moderately long.

Types XLI, XLII, XLIII, XLIV, XLV, XLVI, XLVII, XLVIII, XLIX, L, LI.

PLATE III.

TYPE II. I. III. IV. V.

FLOWERS AND CAPSUSLES.

4. Description of the types.

Group I. Plants with petiolate leaves.

The five types included in this group fall into two classes :—

(A) Forms with ovate leaves, types I and II.

(B) Forms with subcordate leaves, types III, IV, V.

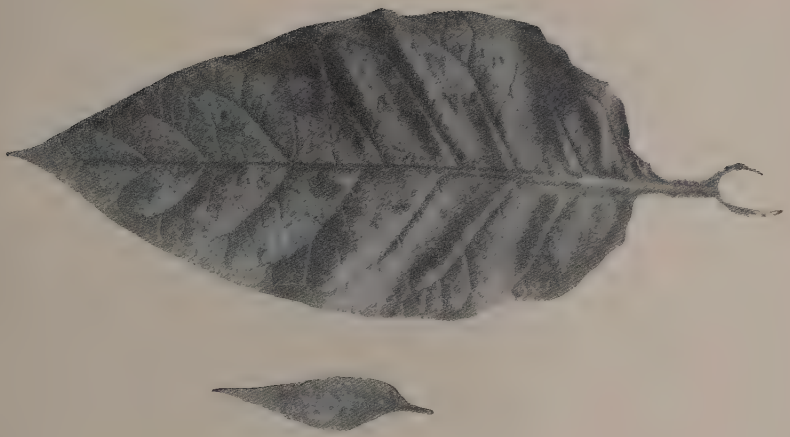
Types I and II resemble each other slightly, but are easily distinguished by the much smaller size of the leaves in type I and its more bushy habit.

Types III and IV are very coarse tall forms. The leaves are almost cordate and very puckered. On superficial inspection III and IV appear to be identical, but they differ in several details connected with the texture of the leaf and the structure of the flower (see description of type IV).

Type V is most easily distinguished from III and IV by its short habit, light green colour, thin texture and the flat surface of its leaves. The leaves in type V are not as cordate as in types III and IV. Types III, IV and V were all obtained from Burma.

Type I. Plants late, tall ; height 143 cms. : the leaves are many, and are all borne in the lower half of the plant, giving it a very bushy appearance ; practically no leaves lie on the ground. *Leaves* petiolate, petioles slightly alate, much more so in the upper leaves ; wings decurrent for about 2·5 cms. down the main stem ; leaves inserted at an angle of 60°—90°, tending to stand out horizontally, ovate, the upper ones narrower than the lower ones ; venation acute-angled ; secondary veins arising at an angle of 60° ; apex acute ; margin with slight regular undulations ; surface somewhat puffy : colour dark green ; texture medium ; average length of petiole 3 cms. ; average length of lamina 33 cms. : ratio length/breadth 2·0. *Inflorescence leaves* petiolate, inserted at an angle of 90°, lanceolate ; apex acuminate ; margin undulate ; surface flat. *Inflorescence* much raised and very conspicuous ; side branches borne at regular intervals all up the main stem, almost as long as the main axis and very spreading. *Flowers* few, a deep pink colour which fades slightly ; length 48 mm. *Calyx* tubular, slightly inflated, less than one-third the length of the corolla ; teeth short and acute. *Corolla* very slender and with a very narrow orifice ; diameter 7 mm. ; the transition between the tube and the dilated portion very gradual, the latter not much wider than the tube ; limb slightly divided with folds at the junctions of the lobes ; lobes rounded at the base with long straight apical points. *Capsule* equal in length to the persistent calyx, conical ; apex blunt.

The anthers burst in the bud and occupy a position just above the stigma. In the fully open flower the burst anthers maintain this position and slightly project from the orifice of the corolla.



TYPE I.

Type II. Plants late, tall; height 150 cms.; lower internodes short, upper ones long; most of the large leaves borne near the ground; no large leaves in the upper two-thirds of the plant. *Leaves* petiolate, petiole is slightly alate in the lower leaves, more so in the upper ones; the wings are decurrent down the main stem for about 2·5 cms.; leaves inserted at an angle of 90° and bend downwards from the top of the petiole, asymmetric; shape varies from ovate to lanceolate according to the position on the stem; venation acute-angled, secondary veins arising at an angle of 45°—60°; apex acute; margin entire or slightly undulate; colour blue-green; texture thick; average length of petiole 6 cms.; average length of lamina 49 cms.; ratio length/breadth 2·5. *Inflorescence leaves* petiolate, petiole not alate, inserted at an angle of 60°—90°, lanceolate; apex acuminate; margin generally entire, sometimes undulate. *Inflorescence* raised, side branches borne at regular distances up the stem, parallel to but not as long as the main axis. *Flowers* a deep pink colour which does not fade much; length 45 mm. *Calyx* slightly globular and inflated, about one-third the length of the corolla; teeth moderately long and acute. *Corolla* with an orifice 8 mm. in diameter, a broad tube, and the transition between the tube and the dilated portion abrupt; limb not very deeply divided with folds at the junctions of the lobes; lobes very rounded at the base; apical points short and somewhat reflexed. *Capsule* much longer than the persistent calyx, conical; apex blunt.

The anthers burst as the flower expands, not in the bud, and at this period are above the stigma. In the fully open flower the burst anthers are about 5 mm. above the stigma and project well beyond the orifice of the corolla.

TYPE II.

Type III. Plants very late, tall; height 150 cms.; lower internodes very short, upper internodes long; some of the lowest leaves lie on the ground, the others are borne at long intervals up the stem. *Leaves* petiolate with alate petioles, the wings of the petiole expand on reaching the stem and are amplexicaul and decurrent for 5 cms.; leaves inserted at an angle of about 60 and bend downwards; shape ovate to cordate; secondary veins arise at an angle of more than 60°; apex acute; margin undulate; leaf undulate; surface puckered; texture thick; colour dark blue green; average length of petiole 5 cms.; average length of leaf 41 cms.; ratio length / breadth 1·5. *Inflorescence leaves* petiolate with very short alate petioles, inserted at an angle of 90°, ovate; apex acuminate; leaf undulate and surface generally puckered. *Inflorescence* with few flowers and with very spreading sideshoots which arise at regular intervals on the upper half of the main stem. The side branches bear very few flowers. *Flowers* pink, the colour easily fades; length 42 mm. *Calyx* globular and inflated, less than one-third the length of the corolla; teeth moderately long and acute. *Corolla* with a broad tube and short dilatation, diameter of orifice 8 mm; the transition between the tube and the expanded portion abrupt; limb not very deeply divided; lobes much rounded, pointed but with no distinct apical points. *Capsule* much shorter than the persistent calyx, conical; apex blunt.

The anthers burst as the flower expands, not in the bud, and occupy a position above the stigma. In the fully open flower, the burst anthers are about 5 mm. above the stigma and project much beyond the orifice of the corolla.

Type IV. Resembles type III exactly except in the following points:—

(1) The leaves are smoother.
(2) The calyx is more inflated.
(3) The lobes of the corolla are mucronate.
(4) The capsule is shorter and broader and about equal in length to the persistent calyx.
(5) The anthers are only slightly raised above the stigma.

TYPE IV.

Type V. Plants somewhat late, not very tall ; height 127 cms. ; lower internodes short causing most of the leaves to be crowded at the base of the plant, a few are borne up the stem. *Leaves* very large and conspicuous, petiolate with alate petioles, the wings are amplexicaul and decurrent on the main stem ; leaves inserted at an angle of about 90° and bend downwards from the base of the petiole ; shape of the lower leaves subcordate, of the upper leaves elliptical ; secondary veins arise at an angle of 60—90° ; apex acute ; margin slightly undulate ; surface very slightly puckered ; colour light green ; texture thin to medium ; average length of petiole 5 cms. ; average length of leaf 45·5 cms. ; ratio length / breadth 1·6. *Inflorescence leaves* petiolate with very short alate petioles, ovate or elliptical ; apex acute ; margin slightly undulate ; surface flat. *Inflorescence* not conspicuous, side branches as long as the main axis, somewhat spreading. *Flowers* a deep pink colour which fades somewhat ; length 45 mm. *Calyx* tubular, inflated, about one-third the length of the corolla ; teeth moderately long and acute. *Corolla* with a very broad tube, almost as broad as the dilatation, the transition between the tube and the dilated portion very gradual ; limb not deeply divided ; lobes rounded at the base, pointed but with no apical points. *Capsule* slightly longer than the persistent calyx, conical ; apex blunt.

The anthers burst in the bud when just below the stigma. In the fully open flower the burst anthers are below the stigma and the latter is level with the orifice of the corolla.

TYPE V.

Type VI. Plants somewhat early, dwarf; height 80 cms.; lower internodes very short, so that all the large leaves form a rosette on the ground. *Leaves* sessile with a tendency to droop from near the base, inserted at an angle of 90°, lanceolate (lamina narrowed towards the base but not as much as in types VII and VIII), auriculate, slightly amplexicaul and sometimes slightly decurrent; secondary veins arise at an angle of 30°, apex acuminate; margin entire, except for very occasional slight undulations at the base of some of the lowest leaves.; surface flat; colour dark green; veins much lighter green; texture thick average length 63 cms.; ratio length to breadth 4·1. *Inflorescence leaves* sessile, inserted at an angle of 90° but droop somewhat, linear, somewhat broader than in types VII and VIII; apex acuminate; margin entire and surface flat, but leaf sometimes undulate at the base. *Inflorescence* less crowded with leaves than in type VIII and with fewer sideshoots, these lie close to the main stem and surpass it in length. *Flowers* very pale pink when opening, white when fully open; length 50 mm. *Calyx* loose but not globular, about half the length of the corolla or less, somewhat deeply divided. *Corolla* with an orifice 9 mm. in diameter; tube 6 mm. wide; the transition between the tube and the dilated portion somewhat abrupt; limb not so deeply divided as in types VII and VIII; lobes not rounded at the base; apical points long and straight. *Capsule* cylindrical; apex pointed; the persistent calyx much longer than the capsule.

Pollination appears to take place in the same manner as in type VIII. The stamens and stigma never reach the orifice of the corolla.

TYPE VI.

Type VII. Plants somewhat early, dwarf; height 78 cms.; owing to the shortness of the lower internodes; the large leaves, which are few in number, are borne near the ground. *Leaves* sessile, inserted in the lower half of the plant at an angle of 90°, in the upper half at an angle of 60°, stiff, thick, do not droop unless flaccid, lanceolate (lamina much narrowed towards the base of the leaf), lower leaves very slightly amplexicaul; venation acute-angled, secondary veins arising at an angle of 30°; apex acuminate; margin entire, except for very occasional slight undulations at the base of some of the lowest leaves; surface flat; colour dark green; veins much lighter green; average length 55 cms.; ratio length / breadth 4-1. *Inflorescence leaves* sessile, inserted at an angle of 45°, linear; apex acuminate; margin generally entire and surface flat, but occasionally the leaf is more or less undulate. *Inflorescence* quite different from that of type VIII, being crowded with linear leaves, which give the plant a bushy appearance, and with many side shoots which arise near the base of the plant and are parallel to and as long as or longer than the main stem. *Flowers* very pale pink when opening, white with pink edges to the petals when fully open; length about 45 mm. *Calyx* somewhat loose but not globular, about half the length of the corolla or less, somewhat deeply divided. *Corolla* with a wide orifice (11 mm.) and a broad tube (6 mm.), the transition from the tube to the dilated portion gradual; limb deeply divided and reflexed; lobes rounded at the base; apical points medium in length and often twisted to one side. *Capsule* short and broad; apex somewhat round; the persistent calyx teeth longer than the capsule.

In the unopened bud the stamens are above the stigma and burst in the bud or just as the flower opens. When the flower is fully open, the stigma is above the anthers which are already empty. Both stigma and anthers project slightly beyond the orifice of the corolla.

TYPE VII.

Type VIII. Plants somewhat early, dwarf; height 115 cms.; internodes equal in length and moderately long, the stiff horizontal leaves thus borne at regular intervals up the stem give the plant a very characteristic appearance. *Leaves* sessile, inserted at an angle of 90°, upper ones at an angle of 60°, stiff and thick, do not droop unless flaccid, auriculate, slightly amplexicaul and decurrent, lanceolate (lamina diminishing to a varying extent at the base of the leaf); venation acute angled, secondary veins arising at an angle of 30°; apex acuminate; margin entire, except for very occasional slight undulations at the base of some of the lowest leaves; surface flat; colour dark green, veins much lighter green; average length 60 cms.; ratio length / breadth 4·4. *Inflorescence leaves* sessile, inserted at an angle of 60° to 90°, linear; apex acuminate; margin entire; surface flat *Inflorescence* with side shoots not as long as the main axis, at first somewhat parallel to the main stem, later somewhat spreading. *Flowers* a deep pink colour at first which fades later to a pale pink; length about 48 mm. *Calyx* tubular, a little less than half as long as the corolla; calyx teeth somewhat long. *Corolla* slender, diameter of the orifice 10 mm., width of the tube 5 mm., the transition between the tube and the dilated portion abrupt; limb deeply divided; lobes rounded at the base; apical points short. *Capsule* long, somewhat narrow, almost covered by the persistent calyx; apex rather pointed

The ripe anthers burst in the bud or as the flower opens when they are just above the stigma. In the open flower the anthers are just above the stigma and the latter is covered with pollen. The anthers and stigma are level with the orifice of the corolla.

TYPE VIII.

PLATE XII.

TYPE IX. XIII. XII. XI. X.

FLOWERS AND CAPSULES.

Sub-class 2. Leaves lanceolate; ratio length to breadth between 3 and 4. The types contained in this sub-class form, as regards habit; a series of which the two extremes are the dwarf form, type IX, with all its leaves forming a rosette on the ground, and type XVII in which the leaves are arranged at regular intervals up the stem, none being on the ground. This sub-class can be conveniently divided into three sub-divisions according to the habit; type XIII may be considered as a transition form between sub-divisions (*b*) and (*c*).

(*a*) Internodes short; all the large leaves form a rosette on the ground.

Only one type (IX) belongs to this sub-division. It is readily distinguished from the other types of this sub-class by the habit and by the peculiar crinkling of the inflorescence leaves.

Type IX. Plants early, dwarf; height 104 cms.; lower internodes very short, causing nearly all the large leaves to lie on the ground. *Leaves* sessile, inserted at an angle of 90°, slightly amplexicaul, lanceolate, lamina much narrowed towards the base; venation acute-angled, secondary veins arising at an angle of 30°; apex acuminate, median leaves prolonged into very long thin points; margin and lamina with deep undulations, lamina raised between the secondary veins, giving the appearance of folds or ridges; colour dark green; texture very thick; average length 56 cms.; ratio length/breadth 3·6. *Inflorescence leaves* sessile, inserted at an angle of 90° and droop downwards from the base, linear; apex acuminate; the whole leaf is very sinuate and sometimes even twisted. *Inflorescence* conspicuous and raised above the leaves, with numerous side shoots which are almost as long as the main axis and not very spreading. *Flowers* a very pale pink colour, short (36 mm.). *Calyx* tubular with long and acute teeth, more than half as long as the corolla. *Corolla* with a wide orifice (11 mm.), and a broad tube, the transition between the tube and the dilated portion somewhat gradual; limb divided to about half its depth; lobes rounded at the base; apical points short, straight and only slightly reflexed. *Capsule* cylindrical with a somewhat blunt apex; persistent calyx longer than the capsule.

In the unopened bud, all the stamens are below the stigma. The anthers burst just as the flower opens while they are still below the stigma or at the most touch the underside with their apices. In the open flowers the stigma is much above the burst anthers and all project beyond the orifice of the corolla. In some of the buds the stigma is visible between the still closed lobes of the corolla.

TYPE IX.

(*b*) Lower internodes short, upper ones gradually elongated ; many large leaves borne close to the ground, a few continued up the stem.

Of the four types belonging to this sub-division type XIII forms a transition between sub-divisions (*b*) and (*c*). Only a few leaves are borne on the ground and several large ones appear on the main stem. In its open habit this type resembles types XIV and XV.

Type X is a short bushy form easily distinguished from the other types in this sub-division by its height and the surface of its leaves. Types XI and XII resemble each other very closely and only differ in some minor details. Type XII is later than type XI with deep pink flowers, while the flowers of the latter are white. The structure of the flowers is also somewhat different.

Type X. Plants early, very short ; height 106 cms.; many of the large leaves form a rosette on the ground, but several are borne up the main stem, giving the plant a slightly bushy appearance. *Leaves* sessile, inserted at an angle of 60° to 90° but droop downwards from about the centre of the leaf, slightly decurrent, slightly auriculate ; shape lanceolate, breadth varies according to the position on the stem ; lamina narrowed towards the base ; venation acute-angled, secondary veins inserted at an angle of about 45° ; apex acute to acuminate ; the margin only may be undulate, or the whole leaf may be undulate, especially the base of the upper leaves ; colour light green ; texture thick ; average length 54 cms. ; ratio length / breadth 4·1. *Inflorescence leaves* sessile, inserted at an angle of 60° to 90°, linear, undulate at the base or quite flat ; apex acuminate. *Inflorescence* somewhat raised, side branches almost as long as the main axis. *Flowers* a pale pink colour which soon fades ; length 45 mm. *Calyx* tubular, somewhat inflated, less than half the length of the corolla ; teeth moderately long and very acute. *Corolla* with an orifice 8 mm. in diameter, the transition between the tube and the dilated portion abrupt ; limb divided to about half its depth ; lobes rounded with pointed apices, but no long apical points. *Capsule* a little shorter than the persistent calyx, slightly conical ; apex somewhat pointed.

The anthers burst while the flower is expanding when they surround the stigma. The anthers and stigma maintain their relative positions in the fully open flower and are opposite the orifice of the corolla.

TYPE X.

Type XI. Plants early ; height 120 cms. ; nearly all the large leaves form a rosette on the ground, but some are borne on the lower half of the stem. *Leaves* sessile, inserted at an angle of 60° or more, and bend downwards at a point very near the base of the leaf, auriculate, amplexicaul, lanceolate, the breadth of the leaf diminishing and the apex becoming more acuminate in passing from the base upwards ; lamina narrowed towards the base of the leaf ; venation acute-angled, secondary veins arising at an angle of 45° ; apex acuminate ; margin and lamina with irregular undulations which increase with the position of the leaf up the stem ; colour dark blue-green ; texture medium to coarse ; average length 52 cms. ; ratio length / breadth 3·5. *Inflorescence leaves* sessile, inserted at an angle of about 90°, linear ; apex acuminate ; margin and lamina generally undulate. *Inflorescence* raised and open, side branches borne at regular intervals up the stem, not so long as the main axis and somewhat parallel to it. *Flowers* white with a faint pink tinge in the buds ; length 50 mm or more. *Calyx* tubular, about one-third the length of the corolla ; teeth long and acute. *Corolla* slender, tube long and the transition between this and the dilated portion very gradual ; limb deeply divided with folds at the junctions of the lobes ; lobes rounded at the base with long, reflexed, apical points. *Capsule* small, a little shorter than the persistent calyx, cylindrical ; apex blunt.

In the bud the ripe anthers are just above the stigma and burst in the bud or as the flower expands. In the open flower the empty anthers are a long distance above the stigma and project just beyond the orifice of the corolla.

TYPE XI.

Type XII. Plants early, but later than type XI; height 129 cms.; nearly all the large leaves form a rosette on the ground, but some are borne on the lower half of the stem; plants more leafy than in type XIII. *Leaves* sessile, inserted at an angle of 60° or more, and bend downwards from a point very near the base of the leaf, auriculate, slightly amplexicaul, shape varies with the position on the stem and may be ovate, elliptical or lanceolate, lamina much narrowed towards the base; venation acute-angled, secondary veins arising at an angle of 30° to 45°; apex acuminate; margin and lamina undulate; colour somewhat blue-green; texture medium to thick; average length 58 cms; ratio length/breadth 3·3. *Inflorescence leaves* sessile, inserted at an angle of more than 90°, linear; apex acuminate; surface sometimes flat, sometimes undulate. *Inflorescence* raised and open, side branches borne at regular intervals up the stem, not as long as the main axis and somewhat spreading. *Flowers* a deep pink colour which does not fade much; length 47 mm. *Calyx* tubular, somewhat inflated; teeth long and acute. *Corolla* with an orifice 8 mm. in diameter, the transition between the tube and the dilated portion slightly abrupt; limb deeply divided; lobes much rounded at the base with straight, moderately long apical points. *Capsule* a little shorter than the persistent calyx, cylindrical, with a blunt apex.

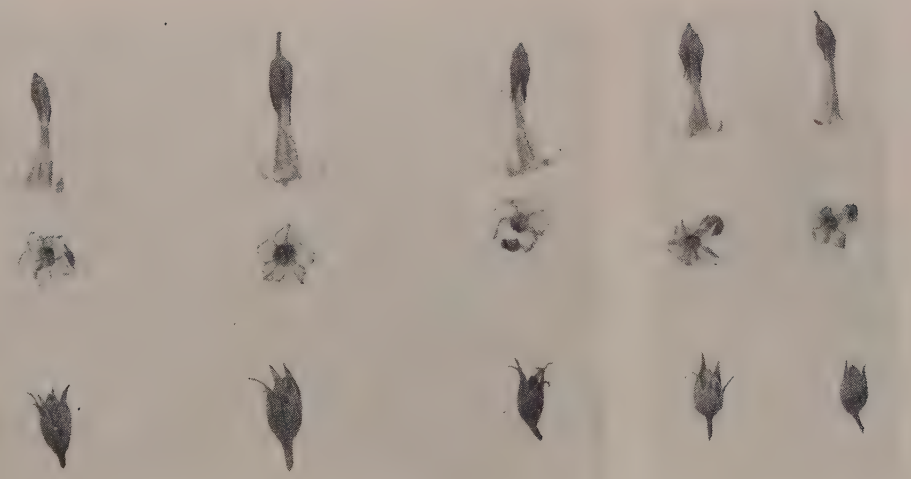
The ripe anthers surround the stigma and burst as the flower opens. In the open flower the burst anthers and stigma are practically level with each other and also with the orifice of the corolla.

TYPE XII.

Type XIII. Plants early ; height 137 cms.; habit open with few large leaves, some form a rosette on the ground, others are borne on the lower half of the stem. *Leaves* sessile, inserted at an angle of more than 60° and bend towards the ground from a point in the centre of the leaf, slightly auriculate (lower leaves more auriculate than the upper ones), slightly amplexicaul ; shape varies according to the position of the leaf and may be ovate, elliptical or lanceolate, lamina narrowed towards the base ; venation acute-angled, secondary veins arising at an angle of about 45° ; apex acuminate ; lamina with deep irregular undulations which become more marked on the leaves borne towards the upper portion of the stem, lower leaves practically flat ; colour light green ; texture medium ; average length 54 cms. ; ratio length/breadth 3·0. *Inflorescence leaves* sessile, inserted at an angle of 90°, linear ; apex acuminate ; lamina often very undulate, sometimes flat. *Inflorescence* raised, side branches arise at long intervals up the main stem ; they are not as long the main axis and remain somewhat parallel to the latter. *Flowers* a deep pink colour which soon fades ; length 45 mm. *Calyx* tubular ; teeth long and acute. *Corolla* with an orifice 8 mm. in diameter, the transition between the tube and the dilated portion abrupt ; limb deeply divided ; lobes rounded at the base with moderately long, straight apical points. *Capsule* shorter than the persistent calyx, cylindrical, with a blunt apex.

The anthers burst in the bud while surrounding the stigma. In the open flower the anthers are slightly above the stigma and both project from the orifice of the corolla.

TYPE XIII.



TYPE XVIII. XV. XIV. XVII. XVI.

FLOWERS AND CAPSULES.

PLATE XVIII.

(*c*) All the internodes moderately long, only two or three leaves on the ground.

Five types (XIV to XVIII) belong to this sub-division. The first three are easily distinguished from the other two by their much greater height, and the greater elongation of their inflorescence. Type XIV bears some resemblance to type XIII of the last sub-division and is distinguished from XV and XVI by the width and paucity of its leaves. Types XV and XVI are very easily distinguished from each other by the shape and surface of their leaves, type XV having more undulate leaves with more acuminate apices than type XVI. Type XVII is a short type with a peculiarly flat-topped inflorescence and very few leaves. The most distinctive character of type XVII is the shape of its leaves in which it shows a resemblance to class B.

Type XIV. Plants early, fairly tall; height 143 cms.; internodes with the exception of the lowest ones moderately long, so that few leaves are borne close to the ground, and the majority are borne up the stem; leaves more numerous than in types XV and XVIII. *Leaves* sessile, inserted at an angle of 90°, but hang vertically downwards from a point near the base of the leaf, slightly amplexicaul, lower leaves slightly decurrent, lanceolate, lamina slightly narrowed towards the base; venation acute-angled, secondary veins arising at an angle of 30° to 45°; apex acuminate: margin slightly undulate, lower leaves flat or slightly undulate, these undulations increase in the upper leaves; colour blue-green; texture medium; average length 48 cms.; ratio length/breadth 3·8. *Inflorescence leaves* sessile, inserted at an angle of 60° to 90°, linear; apex acuminate; lower half of the leaf very undulate. *Inflorescence* raised; side branches borne at regular intervals up the stem, not as long as the main axis, spreading. *Flowers* a deep pink colour which does not fade, long owing to the unusual length of the corolla tube (length 50 mm.). *Calyx* globular, about one-third the length of the corolla; teeth long and acute. *Corolla* with an orifice 8 mm. in diameter, slender, the transition between the tube and the dilated portion gradual; limb deeply divided, but with no folds; lobes much rounded at the base; apical points long and oblique. *Capsule* a little shorter than the persistent calyx, small, conical; apex pointed.

In the unopened bud the anthers are slightly below the stigma. The ripe anthers burst while the flower is expanding when they surround the stigma. In the open flower the burst anthers surround the stigma or are just below it and all project beyond the orifice of the corolla.

Type XV. Plants early, tall; height 143 cms.; habit open; internodes moderately long, except the two or three lowest ones, so that nearly all the leaves are raised above the ground. *Leaves* sessile, inserted at an angle of about 90° and bend downwards from about the centre of the leaf, amplexicaul, very slightly decurrent, auriculate, lanceolate, shape varies with the position of the leaf on the stem, lamina much narrowed for a short distance above the base (in a few leaves the lamina is reduced to a very narrow strip); venation acute-angled, secondary veins arising at an angle of 30° to 45°; apex acuminate; margin and lamina somewhat undulate especially near the base of the leaf; colour light green; texture medium; average length 57 cms.; ratio length/breadth 3·1. *Inflorescence leaves* sessile, inserted at an angle of 90° (apices droop downwards), linear, lamina at the base much reduced; apex acuminate; margin undulate and the basal third of the leaf very undulate. *Inflorescence* much raised; side branches borne at regular intervals on the upper half of the stem, spreading, shorter than the main axis. *Flowers* white, very pale pink in the bud; length 45 mm. *Calyx* tubular and inflated, less than half the length of the corolla; teeth long and acute. *Corolla* with a wide orifice (10 to 11 mm.), the transition between the tube and the dilated portion somewhat gradual; limb deeply divided with folds at the junction of the lobes; lobes much rounded at the base; apical points very long. *Capsule* a little shorter than the persistent calyx, large, conical; apex blunt.

In the unopened bud the anthers are above the stigma and burst just as the flower opens when they are still more raised. In the fully open flower the burst anthers are some distance above the stigma and are nearly level with the orifice of the corolla.

TYPE XV.

Type XVI. Plants somewhat early; height 141 cms.; habit very open, internodes long, only 2 or 3 leaves lie on the ground. *Leaves* sessile, inserted at an angle of 90° and droop downwards from near the base, amplexicaul, sometimes slightly auriculate, decurrent, lanceolate, lamina slightly narrowed at the base; secondary veins arise at an angle of 30° to 45°; apex acuminate; margin entire; lamina flat except for occasional slight undulations at the base of some of the leaves; colour very light green; texture medium; average length 46 cms.; ratio length/breadth 4·1. *Inflorescence leaves* similar to the lower leaves but much narrower, in some cases linear, and the undulations at the base are more marked. *Inflorescence* raised with long side branches which are somewhat parallel to and not as long as the main axis. *Flowers* few in number pale pink; length 50 mm. *Calyx* tubular, somewhat inflated, about one-third the length of the corolla; teeth long and acute. *Corolla* slender, with an orifice 8 mm. in diameter; tube slender, the transition between the tube and the dilated portion slightly abrupt; limb divided to about half its depth; lobes rounded at the base; apices very pointed but no apical point. *Capsule* shorter than the persistent calyx, conical; apex pointed.

The anthers burst in the bud when level with the stigma. In the fully open flowers the empty anthers are just above the stigma and generally slightly project from the orifice of the corolla.

TYPE XVI.

Type XVII. Plants early, short; height 103 cms.; internodes moderately long; leaves borne at regular intervals up the stem, none lie on the ground. *Leaves* sessile, inserted at an angle of 90° or more and droop from the base, amplexicaul, slightly auriculate and slightly decurrent, elliptical or lanceolate; secondary veins arise at an angle of 45° to 60°; apex acuminate; margin slightly undulate, some of the leaves with deep undulations at the base; surface flat; colour blue green; texture medium; average length 39 cms.; ratio length/breadth = 2·8. *Inflorescence leaves* sessile, inserted at an angle of 90° or more, linear; apex acuminate; leaves flat or with a few undulations at the base. *Inflorescence* conspicuous and raised, side branches stout, very spreading, as long as the main axis. *Flowers* numerous, white; length 45 mm. *Calyx* tubular, inflated, a little less than half the length of the corolla; teeth long and acute. *Corolla* with an orifice 9 mm. in diameter, tube broad, the transition between the tube and the dilated portion gradual; limb divided to about half its depth, folded at the junctions of the lobes; lobes rounded at the base with long apical points which are sometimes oblique. Many of the corollas were monstrous in this type in 1908 and 1909. *Capsule* shorter than the persistent calyx, conical; apex pointed.

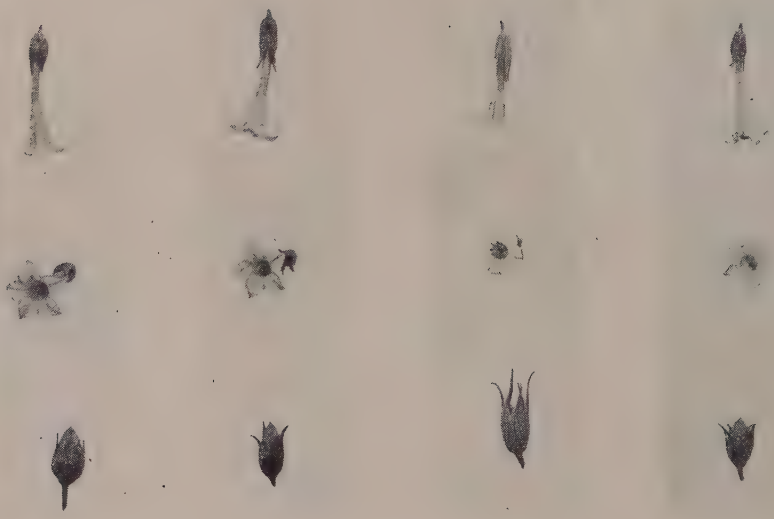
The anthers burst in the bud and are then just above the stigma. In the open flower the stigma and empty anthers maintain their relative positions and are much below the orifice of the corolla.

TYPE XVII.

Type XVIII. Plants somewhat early, later than types XIV and XV, dwarf; height 97 cms.; habit open; internodes moderately long, except the two or three lowest ones, so that nearly all the leaves are raised above the ground. *Leaves* sessile, inserted at an angle of about 60° and droop from a point about one-third from the base of the leaf; shape varies from elliptical to lanceolate according to the position of the leaf on the stem, lamina much narrowed in the basal third of the leaf; leaves slightly amplexicaul, decurrent for about 1·5 cms., slightly auriculate; venation acute-angled, secondary veins arising at an angle of about 45°; apex acute to acuminate; margin slightly undulate, the lamina more or less undulate in the basal portion according to the position of the leaves on the stem; colour light green; texture thin; average length 45·5 cms.; ratio length/breadth 3·0. *Inflorescence leaves* sessile, inserted at an angle of 90°, linear; apex acuminate; margin entire or slightly undulate; leaf flat or somewhat undulate. *Inflorescence* raised above the leaves; side branches borne at regular intervals up the stem from the base upwards, almost as long as, and somewhat parallel to, the main axis. *Flowers* white, very pale pink in the bud, short (length 40 mm.). *Calyx* tubular, less than half the length of the corolla; teeth moderately long and acute. *Corolla* with a very small orifice (7 mm.), slender; the transition between the tube and the dilated portion abrupt; limb deeply divided with folds at the junctions of the lobes; lobes very rounded at the base; apical points short. *Capsule* a little shorter than the persistent calyx, conical; apex pointed.

The anthers burst in the bud when just above the stigma. In the open flower the stamens are decidedly above the stigma and project beyond the orifice of the corolla.

TYPE XVIII.



TYPE XIX. XX. XXI. XXII.

FLOWERS AND CAPSULES.

Class B. Lower leaves broad in the centre, tapering towards both ends ; ratio length to breadth between 2 and 3 ; inflorescence leaves linear or similar to, but narrower than, the lower leaves.

This class contains 15 types and is intermediate in character between class A with very narrow lower leaves and linear inflorescence leaves, and class C in which the lower and inflorescence leaves are broad. The leaves of all the types are alike in being decidedly broad in the centre, but the amount of tapering towards both ends differs somewhat. The types are further subdivided according to habit.

Sub-class 1. Internodes short ; all the large leaves form a rosette on the ground.

Only one type belongs to this sub-class. It is a very free flowering form with broad leaves prolonged into long slender points.

Type XIX. Plants early, dwarf; height 83 cms.; lower internodes exceedingly short, causing all the lower leaves to lie on the ground. *Leaves* sessile, inserted at an angle of 90°, very slightly amplexicaul, the lower leaves very slightly auriculate, elliptical, lamina suddenly narrowed a short distance above the base (in some of the upper median leaves the lamina is practically absent in the lower portion); venation acute-angled, secondary veins arising at an angle of less than 30°; apex acuminate and prolonged into a long point which is often curved to one side; margin with slight regular undulations, the whole lamina deeply undulated and raised between the veins forming folds; colour dark green; texture thick; average length 52 cms.; ratio length/breadth 2·4. *Inflorescence leaves* sessile, inserted at an angle of 90°, linear; apex acuminate; margin slightly undulate, lamina undulate. *Inflorescence* very conspicuous, and raised above the leaves; side shoots numerous, shorter than the main axis and very spreading. *Flowers* a deep pink colour which does not fade, 45 mm. in length. *Calyx* tubular with long acute teeth, less than half as long as the corolla. *Corolla* slender with an orifice 9 mm. in diameter and a narrow tube, the transition between the tube and the dilated portion very gradual; lobes much rounded at the base with long straight points which are reflexed. *Capsule* short, somewhat broader above than below with a blunt apex; the persistent calyx very slightly longer than the capsule, but the calyx teeth stand away from the capsule and do not cover it.

The ripe anthers are just below or surround the stigma and burst as the flower expands. In the open flower the stigma is just above the burst anthers, and both stamens and stigma project slightly beyond the orifice of the corolla.

TYPE XIX.

Sub-class 2. Lower internodes short, upper internodes moderately long : some large leaves on the ground, others up the stem ; leaves numerous ; plants bushy.

Two of the types included in this sub-class are dwarf forms, the third type (XXII) is somewhat tall. The leaf of this latter type is not quite as typical of the class as that of the others, but its general habit supports its inclusion. Type XXI is an exceedingly bushy form with numerous leaves, quite different to type XX, where the habit is open, although the plant is so short. Type XXII has a large leaf of good colour and texture, but is somewhat late.

Type XX. Plants somewhat early, dwarf; height 102 cms.; lower internodes very short, causing nearly all the large leaves to lie on the ground. *Leaves* sessile, inserted at an angle of 90° and droop from a point near the base, slightly amplexicaul, lower leaves broad and ovate, the upper ones more lanceolate, lamina much narrowed towards the base; venation acute-angled; secondary veins arising at an angle of 30°; apex acute; margin with large shallow undulations; lamina raised between the secondary veins, giving the appearance of folds; colour light green; texture thick; average length 56 cms.; ratio length/breadth 2·6. *Inflorescence leaves* sessile; inserted at an angle of 90° or more and droop from the base, linear; apex acuminate; margin almost entire; surface flat. *Inflorescence* raised far above the leaves; side shoots few and not as long as the main stem, very spreading. This combined with the paucity of the inflorescence leaves gives the plant a very open appearance. *Flowers* pale pink when opening, white when open; length 40 mm. *Calyx* tubular, more than half the length of the corolla; teeth long and acute. *Corolla* with a narrow orifice (diameter 8 mm.) and a broad tube, the transition between the tube and the dilated portion very gradual; limb not deeply divided; lobes somewhat rounded, with very short straight points. *Capsule* cylindrical and somewhat blunt, quite covered by the long foliaceous teeth of the persistent calyx, which project far above the apex.

The ripe anthers burst as the flower opens when they are just above the stigma. In the open flower the anthers and stigma are approximately at the same level as the orifice of the corolla.

TYPE XX.

Type XXI. Plants early, dwarf; height 85 cms.; lower internodes short so that most of the large leaves lie on the ground, but the plants have a leafy, bushy appearance on account of the large number of medium-sized leaves borne on the numerous side branches. *Leaves* sessile, inserted at an angle of about 90° and droop downwards at a point about one-third from the base, slightly amplexicaul and sometimes slightly auriculate, the shape varies, lower leaves ovate or elliptical, upper ones ovate or lanceolate, lamina generally much narrowed towards the base; venation acute-angled, secondary veins arising at an angle of 30°; apex acuminate with a long slender point; margin very undulate, lamina with deep undulations and raised between the veins, giving the appearance of folds; colour dark green; texture thick; average length 52 cms.; ratio length/breadth 2·8. *Inflorescence leaves* sessile, inserted at an angle of 60° to 90° and droop downwards at a point one-third from the base, lanceolate to linear; apex acuminate ending in a long thread-like point; margin and lamina very undulate. *Inflorescence* not exceedingly conspicuous or raised; side branches spring from the base, and are longer than the main axis, somewhat spreading and bear many leaves. *Flowers* pink, the colour does not fade; length 45 mm. *Calyx* tubular, length less than half that of the corolla; teeth long and acute. *Corolla* very slender, diameter of the orifice 8 mm., the transition between the tube and the dilated portion slightly abrupt; limb deeply divided; lobes rounded at the base with long straight apical points which are reflexed. *Capsule* cylindrical, with pointed apex; calyx longer than the capsule.

In this type the anthers do not burst until the corolla begins to expand. In the unopened bud the anthers at first surround the stigma and later are raised above it. In the open flower the stigma is always below the stamens and below the opening of the corolla. The longest stamens project beyond the orifice of the corolla.

TYPE XXI.

Type XXII. Plants rather late, short but not dwarf; height 117 cms.; many of the large leaves form a rosette on the ground, but some are borne on the lower half of the stem. The raising of the inflorescence above the leaves gives this type an open appearance and distinguishes it from type XXI. *Leaves* sessile, inserted at an angle of 45°, but the upper half of the leaf bends over until it is horizontal, slightly amplexicaul; secondary veins arise at an angle of 45°; shape ovate, upper leaves ovate-lanceolate, lamina narrowed for a very short distance above the base; apex acuminate; margin with shallow regular undulations, otherwise lamina and surface flat; colour light green; texture thin; average length 54 cms.; ratio length/breadth 2·3. *Inflorescence leaves* sessile, inserted at an angle of 60° to 90°, lanceolate to linear; apex acuminate; margin entire and leaf flat. *Inflorescence* raised above the leaves and conspicuous, side branches arise some distance above the base and are not as long as the main axis. *Flowers* a deep pink colour which fades slightly, very long (length 50 mm.). *Calyx* somewhat globular, about one-third the length of the corolla, somewhat inflated. *Corolla* slender, diameter of the orifice 8 mm., the transition between the tube and the dilated portion gradual; limb deeply divided; lobes rounded at the base and pointed at the apex, with a short apical point. *Capsule* much longer than the persistent calyx, conical; apex pointed.

The anthers do not burst until the corolla is expanding when they surround the stigma or are slightly above it. In the fully open flower the burst anthers are slightly above the stigma and level with the orifice of the corolla.

TYPE XXII

PLATE XXIX.

TYPE XXIII. XXIV. XXX. XXXII. XXXI. XXXIII. XXV. XXVI. XXVIII.

FLOWERS AND CAPSULES.

Sub-class 3. Lower internodes short, upper internodes very long, most of the large leaves borne on the ground, plants tall, inflorescence open with few flowers.

This is a well-defined group of tall tobaccos. Eleven types are contained in it, of which no less than nine are from Bihár. They are characterised by their height, lateness, the sparseness and deep pink colour of the flowers, open character of the inflorescence and the peculiar folding over at the midrib of the leaves. Types XXIII and XXIV are not as typical of this group as the other forms. These eleven types may be distinguished among themselves by differences in the shape of the leaf, number of branches, and by the amount of crumpling or puckering of the leaf surface. Types XXVIII & XXIX are easily distinguished from all the others by the glossy surface of their leaves and the light colour of the veins. They are almost identical, but differ so markedly in time of flowering that it was necessary to maintain them as separate types. Type XXVIII was obtained from Bihár and type XXIX from the Central Provinces.

Type XXIII. Plants somewhat early; height 136 cms.; leaves few, lower internodes short, causing some of the leaves to be borne very near the ground, upper internodes long; inflorescence raised in a few long slender branches. *Leaves* sessile, inserted at an angle of 90° and bend downwards from near the base, amplexicaul, very slightly decurrent, elliptical, lamina slightly narrowed towards the base; secondary veins arise at an angle of nearly 90°; apex acuminate; margin and base of leaf undulate; surface puckered; leaf not fully expanded but folded on the midrib; colour yellowish green; texture thick; average length 46 cms.; ratio length/breadth 2·5. *Inflorescence leaves* similar to the lower leaves but narrower. *Inflorescence* raised on a few, long, spreading branches. *Flowers* few, pale pink; length 45 mm. *Calyx* tubular, somewhat inflated, a little less than half the length of the corolla; teeth moderately long and acute. *Corolla* with an orifice 8 mm. in diameter; tube broad, the transition between the tube and the dilated portion somewhat abrupt; limb divided to about half its depth; lobes not rounded at the base; apical points long and sometimes oblique. *Capsule* shorter than the persistent calyx, cylindrical; apex blunt.

The anthers burst in the bud or as the flower is expanding and are then just above the stigma. In the fully open flower the empty anthers and the stigma maintain their relative positions and are level with the orifice of the corolla.

TYPE XXIII.

PLATE XXX.

Type XXIV. Plants very late; height 149 cms.; lower internodes very short, causing some of the leaves to lie on or near the ground, upper internodes long; inflorescence raised on the main axis, with secondary branches at the top only. *Leaves* sessile, inserted at an angle of 45°, bending over to become more or less horizontal, amplexicaul, slightly auriculate, decurrent for about 2·5 cms., elliptical, lamina narrowed for a short distance above the base; secondary veins arise at an angle of 60° or more; apex acuminate; margin with slight regular undulations; surface puckered and raised between the secondary veins; colour blue-green; average length 52 cms.; ratio length/breadth 2·6. *Inflorescence leaves* similar to the lower leaves but lanceolate and with occasional deep undulations at the base. *Inflorescence* much raised on the main axis with a few spreading side-branches borne near the apex. *Flowers* pink; length 45 mm. *Calyx* tubular, somewhat inflated, a little less than half the length of the corolla; teeth long and acute. *Corolla* with an orifice 8 mm. in diameter, and a broad tube, the transition between the tube and the dilated portion slightly abrupt; limb divided to about half its depth, with small folds at the junctions of the lobes; lobes much rounded at the base; apical points short. *Capsule* slightly shorter than the persistent calyx, cylindrical; apex pointed.

The anthers burst as the bud expands when just level with or just above the stigma. In the open flower the stigma and anthers are in the same relative positions and are level with the orifice of the corolla.

TYPE XXIV.

PLATE XXXI

Type XXV. Plants very late, tall ; height 165 cms. ; leaves few ; lower internodes very short, a few leaves borne on the ground, upper internodes very long ; inflorescence much raised on long slender branches ; flowers sparse. *Leaves* sessile, inserted at an angle of 60°, the upper half becoming horizontal, amplexicaul, slightly auriculate, decurrent, the decurrent portion very narrow ; shape elliptical, lamina reduced in the basal fifth of the leaf ; secondary veins arise at an angle of 45° ; apex acute ; margin with deep irregular undulations ; surface puckered ; leaf not expanded but folded on the midrib ; colour yellowish green ; texture coarse to medium ; average length 54 cms. ; ratio length/breadth 2·8. *Inflorescence leaves* similar to the lower leaves, but narrower and not amplexicaul or decurrent. *Inflorescence* much raised on long slender branches, which are parallel to the main stem. *Flowers* sparse, a very deep pink colour which does not fade ; length 45 mm. *Calyx* tubular, inflated, less than half the length of the corolla ; teeth moderately long and acute. *Corolla* with a wide orifice (11 to 12 mm. in diameter), tube broad, the transition between the tube and the dilated portion gradual ; limb divided to about half its depth, fully expanded with folds at the junctions of the lobes ; lobes rounded at the base with very short apical points. *Capsule* equal in length to the persistent calyx, cylindrical ; apex blunt.

The anthers burst as the flower expands when they are approximately level with the stigma. The stigma and empty anthers retain their relative positions in the fully open flower and are level with the orifice of the corolla.

TYPE XVI

Type XXVI. Plants late, tall ; height 175 cms. ; leaves few ; lower internodes very short, causing some leaves to lie on the ground, upper internodes very long ; inflorescence much raised on numerous long slender branches ; flowers sparse. *Leaves* sessile, inserted at an angle of about 60° and droop downwards from a point near the base, slightly amplexicaul and auriculate, decurrent, the decurrent portion very narrow ; shape ovate, lamina reduced in the basal fifth of the leaf ; secondary veins arise at an angle of 45° ; apex acute ; margin with large irregular undulations ; surface puckered ; leaf not expanded but folded on the midrib ; colour light green ; texture coarse ; average length 53 cms. ; ratio length/breadth 2·4. *Inflorescence leaves* similar to the lower leaves. *Inflorescence* much raised on long slender branches, which are somewhat spreading in habit. *Flowers* sparse, a very deep pink colour which does not fade ; length 45 mm. *Calyx* tubular, slightly inflated, a little less than half the length of the corolla ; teeth moderately long and acute. *Corolla* with an orifice 8 mm. in diameter and a fairly broad tube, the transition between the tube and the dilated portion gradual ; limb divided to about half its depth, not fully expanded, with folds at the junctions of the lobes ; lobes rounded at the base with short apical points. *Capsules* approximately equal in length to the persistent calyx, cylindrical ; apex blunt.

The anthers burst as the flower expands when they are approximately level with the stigma. In the fully open flower the empty anthers and the stigma maintain their relative positions and are nearly level with the orifice of the corolla.

TYPE XXVI.

Type XXVII. Plants late, tall; height 163 cms.; leaves neither few nor very numerous; lower internodes very short, causing some of the leaves to lie on the ground, upper internodes very long; inflorescence much raised on long slender branches; flowers sparse. *Leaves* sessile, inserted at an angle of about 60°, the upper portion tending to become horizontal, slightly amplexicaul and auriculate, decurrent, the decurrent portion very narrow; shape ovate, lamina reduced in the basal fifth of the leaf; secondary veins arise at an angle of 45°; apex acuminate; margin and lamina very undulate (more so than in type XXVI); surface very puckered; leaf not expanded but folded on the midrib; colour light green; texture coarse; average length 55 cms.; ratio length/breadth 2·6. *Inflorescence leaves* similar to the lower leaves but narrower. *Inflorescence* much raised on long, slender, spreading branches. *Flowers* sparse, a deep pink colour; length 45 mm. *Calyx* tubular, inflated, less than half the length of the corolla; teeth moderately long and acute. *Corolla* with a wide orifice (11 to 12 mm.), and a broad tube, the transition between the tube and the dilated portion gradual; limb divided to about half its depth, fully expanded with folds at the junctions of the lobes; lobes rounded at the base with very short apical points. *Capsule* equal in length to the persistent calyx, cylindrical; apex blunt.

The anthers burst as the flower expands when they are approximately level with the stigma. In the fully open flower the stigma and empty anthers retain their relative positions and are level with the orifice of the corolla.

TYPE XXVII.

Type XXVIII. Plants very late, tall ; height 159 cms. ; leaves numerous ; plants bushy ; lower internodes very short, causing many leaves to lie on or near the ground, upper internodes very long ; inflorescence much raised on numerous long, slender branches ; flowers sparse. *Leaves* sessile, inserted at an angle of about 45°, and bend downwards from the centre of the leaf, amplexicaul, decurrent for 4 to 7·5 cms., the decurrent strip of lamina very narrow ; shape elliptical ; breadth of the leaf decreasing with its position up the stem, lamina much reduced in the basal third of the leaf ; apex acuminate ; secondary veins arise at an angle of 45°, veins much lighter in colour than the lamina, and therefore very conspicuous ; margin very undulate ; surface puckered, lamina raised between the secondary veins, giving the appearance of folds or ridges ; leaf not expanded but folded on the midrib ; colour glossy bright green ; texture medium to thick ; average length 50 cms. ; ratio length/ breadth 2·5. *Inflorescence leaves* very similar to the lower leaves except as regards their shape which is lanceolate. *Inflorescence* much raised on long slender branches which are somewhat spreading in habit. *Flowers* sparse, a very deep pink colour which does not fade ; length 45 mm. *Calyx* tubular, inflated, a little less than half the length of the corolla ; teeth short and acute. *Corolla* with an orifice 8 mm. in diameter, and a fairly broad tube, the transition between the tube and the dilated portion gradual ; limb divided to about half its depth with folds at the junctions of the lobes ; lobes rounded at the base ; apical points short ; limb never fully expanded. *Capsule* a little longer than the persistent calyx, cylindrical ; apex blunt.

The anthers burst in the bud when just above or just level with the stigma. In the open flower they maintain their relative positions and are below the orifice of the corolla.

Type XXIX resembles type XXVIII in every particular, but is much earlier in flowering.

TYPE XXVIII.

Type XXX. Plants late, tall ; height 163 cms. ; leaves numerous ; plants bushy ; lower internodes very short, causing many leaves to lie on or near the ground, upper internodes very long ; inflorescence much raised on numerous long, slender branches ; flowers sparse. *Leaves* sessile, inserted at an angle of about 60°, the upper portions tending to become horizontal, amplexicaul, auriculate, decurrent for about 4 cms., the decurrent portion being first broad, then narrow ; shape elliptical, the lamina reduced during the basal fifth of the leaf ; apex acuminate ; secondary veins arise at an angle of 45° ; margin with very slight undulations ; surface almost flat ; leaf not expanded but folded on the midrib ; colour yellowish green ; texture thin ; average length 54 cms. ; ratio length/breadth 2·4. *Inflorescence leaves* very similar to the lower leaves, except as regards their shape which is lanceolate. The lamina at the base of these leaves is also often deeply undulate. *Inflorescence* much raised on long, slender branches which are somewhat spreading in habit. *Flowers* sparse, a very deep pink colour which does not fade ; length 50 mm. *Calyx* tubular, somewhat inflated, about one-third the length of the corolla ; teeth moderately long and acute. *Corolla* with an orifice 9 mm. in diameter, and a somewhat broad tube, the transition between the tube and the dilated portion very gradual ; limb divided to about half its depth with folds at the junctions of the lobes ; the lobes rounded at the base ; apical points short. *Capsule* equal in length to the persistent calyx, cylindrical and blunt.

The anthers burst as the flower expands while they surround or are slightly above the stigma. In the open flower the burst anthers and stigma maintain their relative positions and are below the level of the orifice of the corolla.

TYPE XXX.

Type XXXI. Plants very late, tall; height 177 cms.; leaves numerous; plants very bushy; lower internodes very short, causing many leaves to lie on or close to the ground, upper internodes long; inflorescence raised on long branches which bear numerous small leaves. *Leaves* sessile, inserted at an angle of about 60°, the upper part bending downwards, amplexicaul, auriculate, decurrent for about 2·5 cms.; shape ovate to elliptical, the lamina reduced in the basal fifth of the leaf; secondary veins arise at an angle of 45° to 60°; apex acuminate; lamina with irregular deep undulations (but less so than in type XXXII); surface puckered and ridged between the secondary veins; leaf not expanded but folded on the midrib; colour yellowish green; texture medium (thinner than type XXXII); average length 53 cms.; ratio length/breadth 2·1. *Inflorescence leaves* similar to the lower leaves. *Inflorescence* raised on long branches which are parallel and equal in length to the main axis. *Flowers* sparse, a deep pink colour which does not fade; length 45 mm. *Calyx* tubular, somewhat inflated, about one-third the length of the corolla; teeth short and acute. *Corolla* with an orifice 9 mm. in diameter, tube medium, the transition between the tube and the dilated portion somewhat abrupt; limb divided to about half its depth, fully expanded with folds at the junctions of the lobes; lobes rounded at the base with short apical points. *Capsule* equal in length to the persistent calyx, cylindrical; apex blunt.

The anthers burst while the flower expands when they are just above the stigma. In the fully open flowers the burst anthers occupy the same relative position to the stigma and project from the orifice of the corolla.

TYPE XXXI.

Type XXXII. Plants very late, tall; height 179 cms.; leaves numerous; plants bushy; lower internodes very short, causing many leaves to lie on or near the ground, upper internodes very long; inflorescence raised on long branches bearing many small leaves; flowers sparse. *Leaves* sessile, inserted at an angle of 60°, the upper half of the leaf bends downwards, amplexicaul, auriculate, decurrent for 3 to 4 cms., ovate to elliptical, the lamina reduced in the basal fifth of the leaf; secondary veins arise at an angle of 60°; apex acuminate; lamina with deep irregular undulations; surface very puckered and ridged between the secondary veins; leaf not expanded but folded on the midrib; colour rather light yellowish green; texture medium; average length 51 cms.; ratio length/breadth 2·1. *Inflorescence leaves* similar to the lower ones but narrower. *Inflorescence* raised on long branches which are parallel and equal in length to the main axis. *Flowers* sparse, a deep pink colour which does not fade; length 45 mm. *Calyx* tubular, inflated, a little less than half the length of the corolla; teeth moderately long and acute. *Corolla* with an orifice 9 mm. in diameter, tube medium, the transition between the tube and the dilated portion gradual; limb divided to about half its depth, fully expanded with folds at the junctions of the lobes; lobes much rounded at the base with short apical points. *Capsule* slightly longer than the persistent calyx, conical; apex blunt.

The anthers burst while the corolla is expanding, when they are at first round and later above the stigma. In the fully open flower the burst anthers are above the stigma and almost on a level with the corolla opening.

TYPE XXXII.

Type XXXIII. Plants very late, tall, bushy; height 188 cms.; leaves numerous; lower internodes very short, causing many leaves to lie on or near the ground, upper internodes long; inflorescence raised on long branches which bear many small leaves. *Leaves* sessile, inserted at an angle of about 60°, the upper part bending downward, amplexicaul, auriculate, decurrent for about 2·5 cms.; shape ovate to elliptical, the lamina reduced in the basal fifth of the leaf; secondary veins arise at an angle of 45° to 60°; apex acuminate; leaf with irregular very deep undulations; surface very puckered and ridged between the secondary veins; leaf not expanded but folded on the midrib; colour yellowish green; texture medium; average length 51 cms.; ratio length/breadth 1·9. *Inflorescence leaves* similar to the lower leaves. *Inflorescence* raised on long branches which are equal in length to the main axis and somewhat spreading. *Flowers* sparse, a deep pink colour which does not fade; length 45 mm. *Calyx* somewhat globular, inflated, about one-quarter the length of the corolla; teeth short and somewhat acute. *Corolla* with an orifice 9 mm. in diameter, tube medium, the transition between the tube and the dilated portion somewhat abrupt; limb divided to about half its depth, fully expanded with folds at the junctions of the lobes; lobes rounded at the base with short apical points. *Capsule* approximately equal in length to the persistent calyx, conical; apex blunt.

The anthers burst just as the bud opens and then surround or are slightly above the stigma. In the fully open flowers the stigma is generally a little above the burst anthers (or it may be level with them) and level with or projecting slightly beyond the orifice of the corolla.

TYPE XXXIII.

PLATE XL.

TYPE XXXVI. XXXVIII. XL. XXXIX. XXXIV. XXXVII. XXXV.

FLOWERS AND CAPSULES.

Class C. Leaves elliptical, broad ; lamina at the base only slightly reduced ; apex acute ; ratio length to breadth about 2 ; inflorescence leaves always similar to the lower leaves.

This class contains the types which will probably prove the most valuable. The leaves are broad, large and the midribs are not so pronounced as in class A. The distinctive feature is the shape of the leaves which is broad throughout and only slightly narrowed for a very short distance above the base. The broad inflorescence leaves are also very characteristic. On the whole the inflorescence is not much raised, nor as free flowering as in class A, while the more compact form of the plants with large leaves continued up the stem is very different to the open habit and basal crowding of the leaves in class B.

Sub-class I. Lower internodes short, upper internodes moderately long.

Of the seven types included in this sub-class type XL is not very typical, but appeared to be nearer the types in this class than those of any other. Type XXXVI with linear inflorescence leaves is also somewhat anomalous, but the shape of the lower leaves necessitated its inclusion here rather than in class B. Type XXXIV with its very long leaves and type XXXV with exceedingly broad leaves are most distinctive and very easily recognised in the field. Type XXXVII in the shape of its leaves is not absolutely typical. The small angle of inset of the leaves and their flatness and stiffness are characteristic of this form. Type XXXVIII has a peculiarly shaped corolla in which the dilated portion is exceedingly short and the tube very broad. No other type among the Indian tobaccos has a corolla of this shape. Type XXXIX is somewhat like XXXVIII in habit, but is easily distinguished from the latter by the leaf shape.

Type XXXIV. Plants late, short ; height 112 cms. ; lower internodes short, almost all the large leaves are borne on or near the ground, upper internodes long, but the leaves borne up the main stem are comparatively small. *Leaves* sessile, inserted at an angle of 60° to 90° and stand out more or less horizontally, auriculate, amplexicaul, decurrent, elliptical, lamina not narrowed at the base ; secondary veins arise at an angle of 60° to 90° ; apex acuminate with a long, slender point which is sometimes curved ; margin slightly undulate ; surface slightly raised between the secondary veins and sometimes puckered ; colour dark blue-green ; texture medium ; average length 58 cms. ; ratio length/breadth 2·2. *Inflorescence leaves* similar to the lower leaves. *Inflorescence* not conspicuous with several long side branches which are somewhat spreading and not as long as the main axis. *Flowers* few, pale pink in colour ; length 40 mm. *Calyx* globular, inflated, a little less than half the length of the corolla ; teeth short and acute. *Corolla* with an orifice 8 mm. in diameter, and a broad tube, the transition between the tube and the dilated portion slightly abrupt ; limb divided to about half its depth with folds at the junctions of the lobes ; lobes rounded at the base ; apical points long and sometimes oblique. *Capsule* slightly shorter than the persistent calyx, cylindrical ; apex blunt.

The anthers burst as the bud opens and are then well above the stigma. In the fully open flower the burst anthers are 5 mm. above the stigma and are approximately level with the orifice of the corolla.

TYPE XXXIV.

Type XXXV. Plants somewhat early, short with exceedingly broad leaves; height 106 cms.; internodes very short, several leaves lie on the ground. *Leaves* sessile, inserted at an angle of 60° afterwards becoming horizontal, auriculate, amplexicaul, decurrent for about 1 cm., the decurrent portion of the lamina being very broad, elliptical; secondary veins arise at an angle of 90°; apex acute; margin with slight regular undulations; surface puckered; colour blue-green; texture thin; average length of leaf 48 cms.; ratio length/breadth 1·5. *Inflorescence leaves* resemble the lower leaves in every particular but are smaller. *Inflorescence* inconspicuous, scarcely raised and much hidden by the large leaves; side branches few, short and spreading. *Flowers* large, a very deep pink colour which does not fade; length 50 mm. *Calyx* globular, inflated, about one-third the length of the corolla; teeth short and obtuse. *Corolla* with an exceedingly broad tube; diameter of the orifice about 10 mm.; transition between the tube and the dilated portion abrupt; limb entire with slight indentations between the lobes which have no apical points. *Capsule* equal in length to the persistent calyx, broad, conical; apex blunt.

The anthers and stigma are at the same level both in the expanding bud and in the fully open flower. The anthers burst just as the flower opens. Both anthers and stigma remain just below the level of the corolla orifice.

TYPE XXXV.

Type XXXVI. Plants early, dwarf ; height 100 cms. ; most of the large leaves form a rosette on the ground owing to the shortness of the lower internodes, but some fairly large leaves are borne up the stem and give the plant a bushy, leafy appearance. *Leaves* sessile, inserted at an angle of 90°, and droop downwards, elliptical, lamina very slightly narrowed towards the base, slightly auriculate, amplexicaul ; venation acute-angled, secondary veins arising at an angle of 45 to 60° ; apex acuminate ; margin with regular slight undulations, but leaf and surface flat ; colour blue-green ; texture thin ; average length 47 cms. ; ratio length/breadth 2·0. *Inflorescence leaves* sessile, inserted at an angle of 90° and droop towards the ground, lanceolate to linear ; apex acuminate ; margin slightly undulate. *Inflorescence* not very conspicuous ; side branches arise near the base and are not as long as the main axis, very spreading. *Flowers* a pale pink colour which fades to white ; length 45 mm. *Calyx* globular, less than half the length of the corolla ; teeth long and acute. *Corolla* with a broad tube, orifice 9 mm. in diameter, the transition between the tube and the dilated portion somewhat abrupt ; limb slightly divided with folds between the lobes ; lobes much rounded ; apical points short and straight. *Capsule* conical with a blunt apex ; calyx longer than the capsule.

The anthers burst while surrounding the stigma, later the burst anthers are found far above the stigma. Only the longest stamens reach the orifice of the corolla.

TYPE XXXVI.

Type XXXVII. Plants somewhat early, short; height 107 cms.; lower internodes short; many of the large leaves are borne near the ground but a few are borne up the main stem; leaves numerous and large. *Leaves* sessile, inserted at an angle of 45 to 60°, slightly auriculate, slightly amplexicaul, decurrent for about 5 cms., elliptical, lamina narrowed in the basal fourth of the leaf; secondary veins arise at an angle of 60° or more; apex acute; margin generally entire and flat but occasionally regularly and slightly undulate; surface sometimes slightly raised near the edge; colour dark green; texture thick; average length 48 cms.; ratio length/breadth 2·7. *Inflorescence leaves* similar to the lower leaves but lanceolate in shape and with acuminate apices. *Inflorescence* many-flowered with long side shoots which are not as long as the main axis. *Flowers* pink; length 45 mm. *Calyx* globular, inflated, about one-third the length of the corolla; teeth short and acute. *Corolla* with a wide orifice (10 mm. in diameter), tube long and of medium width, the transition between the tube and the dilated portion abrupt; limb divided to about half its depth, folded at the junctions of the lobes; lobes rounded at the base with short apical points. *Capsule* longer than the persistent calyx, conical; apex blunt.

The anthers burst as the corolla expands and are then approximately level with the stigma. They maintain this position in the fully open flower and are level with the orifice of the corolla.

TYPE XXXVII.

Type XXXVIII. Plants somewhat late and tall ; height 134 cms.; internodes short giving the plant a somewhat bushy appearance, several large leaves near the ground. *Leaves* sessile, inserted at an angle of 60°, the upper portions of the leaves tend to become horizontal, amplexicaul, auriculate, decurrent, elliptical, lamina only narrowed just at the base ; secondary veins arise at an angle of 60° ; apex acute ; margin with regular very small undulations ; surface slightly puckered ; colour light green ; texture thin ; average length 47 cms.; ratio length/breadth 1·8. *Inflorescence leaves* similar to the lower leaves. *Inflorescence* not conspicuous and not much raised. *Flowers* very pale pink in colour ; length 45 mm. *Calyx* globular, inflated, about one-quarter the length of the corolla ; teeth moderately long and acute. *Corolla* with a wide orifice (diameter 10 mm.), tube exceedingly broad and the dilated portion very short, the transition between the latter and the tube very abrupt (the shape of the corolla in this type is unique among the Indian tobaccos) ; limb quite entire. *Capsule* longer than the persistent calyx, conical ; apex pointed.

The anthers do not burst in the bud but as the corolla expands, when the anthers are well above the stigma. In the fully open flower the burst anthers are about 5 mm. above the stigma and project from the orifice of the corolla.

TYPE XXXVIII

Type XXXIX. Plants somewhat late; height 128 cms.; internodes moderately long, no leaves borne on the ground; leaves large and numerous. *Leaves* sessile, inserted at an angle of about 60° and tend to bend over at the apex, amplexicaul, auriculate, decurrent for 2·5 cms. or more, elliptical, lamina much reduced for a short distance above the base; secondary veins arise at an angle of nearly 90°; apex acute; margin with slight regular undulations; surface slightly puckered and raised between the secondary veins; colour light green; texture thin; average length 45 cms.; ratio length/breadth 1·9. *Inflorescence leaves* similar to the lower leaves but narrower and not auriculate or decurrent. *Inflorescence* not conspicuous with a few spreading side branches. *Flowers* pink in colour; length 40 mm. *Calyx* somewhat globular, inflated, a little less than half the length of the corolla; teeth short and acute. *Corolla* with a very narrow orifice (diameter 7 mm.) and a broad tube, the transition between the tube and the dilated portion gradual; limb somewhat deeply divided with folds at the junctions of the lobes; lobes rounded and pointed but without an apical point. *Capsule* slightly longer than the persistent calyx, conical; apex pointed.

The anthers burst in the bud when below the stigma. In the fully open flower the empty anthers are level with the stigma and project with the latter beyond the orifice of the corolla.

TYPE XXXIX.

Type XL. Plants very early, short; height 118 cms., lower internodes short, causing a few of the leaves to lie on or near the ground, upper internodes long, the majority of the large leaves being borne at regular intervals up the stem. *Leaves* sessile, inserted at an angle of 60°, amplexicaul, auriculate, decurrent for about 2·5 cms. (the decurrent portion broad), elliptical, lamina slightly narrowed in the basal fifth of the leaf; secondary veins arise at an angle of 60°; apex acute; margin entire; surface flat; a few deep undulations at the base of the leaves; colour bright green; texture medium; average length 42 cms.; ratio length/breadth 2·1. *Inflorescence leaves* similar to the lower leaves but lanceolate in shape. *Inflorescence* raised with several long side branches which are parallel to, but not as long as, the main axis. *Flowers* a deep pink colour which does not fade much; length 45 mm. *Calyx* globular, inflated, about one-third the length of the corolla; teeth moderately long and acute. *Corolla* with an orifice 8 mm. in diameter, and a broad tube, the transition between the tube and the dilated portion gradual; limb divided to about half its depth; lobes rounded at the base with pointed apices, but no apical point. *Capsule* large and stout, shorter than the persistent calyx, conical; apex pointed.

The anthers burst just as the bud expands when they are about 5 mm. above the stigma. In the fully open flower the stigma and empty anthers maintain their relative positions and are approximately level with the orifice of the corolla.

TYPE XL.

TYPE LI. XLIX. L. XLVIII. XLVII. XLI. XLV. XLVI.

FLOWERS AND CAPSULES.

Sub-class 2. All the internodes equal in length and moderately long.

There is great diversity in height in the eleven types belonging to this sub-class, but a wonderful uniformity in leaf shape and structure of the flower. Types XLI, XLIII, XLIV and XLV form a series increasing in height and in size of leaf. In other respects they resemble each other very closely. The flowers are of the same type, but show small differences in the amount of indentation of the corolla limb, length of the apical point, etc. (see Plate XLVIII). Types XLI and XLII are almost indistinguishable from one another, but differ persistently from year to year in the size, colour and texture of their leaves. Type XLVI differs somewhat from this series in the shape of the leaves which are narrowed above the base to a slightly greater extent.

Types XLVIII, XLIX, L, LI resemble each other very closely in the shape of their leaves and the structure of their flowers and capsules. Types L and LI are exceedingly alike, but type L is shorter and its leaves are more vertical and darker in colour than those of type LI.

Type XLVIII is very like LI, but is much shorter and the angle of inset of the leaves is 90° instead of 60°. In type XLIX the leaves are exceedingly vertical. Types XLVIII, XLIX, L and LI form a series as regards height and differ in the angle of insertion of the leaves. Type XLIX is easily distinguished in the field by the light colour of its leaves.

Type XLI. Plants very early, dwarf; height 108 cms.; very bushy plants with short internodes, numerous small leaves and many side branches, no leaves are borne on the ground and the lowest portion of the plant is the narrowest. *Leaves* sessile, inserted at an angle of 60°, very slightly auriculate, amplexicaul and decurrent to a varying amount which may be as much as 2·5 cms., the decurrent portion of the lamina very broad; shape elliptical, lamina very slightly narrowed towards the base; secondary veins arise at an angle of nearly 90°; apex acute; margin with occasional large undulations which are more frequent towards the base of the leaf; surface very slightly puckered; colour blue-green; texture medium; average length of leaf 27 cms.; ratio length to breadth 2·1. *Inflorescence leaves* resemble the lower leaves in every respect but are smaller. *Inflorescence* not conspicuous and not much raised with numerous side branches which surpass the main axis in height and are parallel to it. *Flowers* a very deep pink colour; length 44 mm. *Calyx* globular, less than one-third the length of the corolla; teeth short and obtuse. *Corolla* with an opening 8 mm. in diameter, the transition between the tube and the dilated portion abrupt; limb undivided but with slight indentations between the lobes and very small apical points. *Capsule* slightly longer than the persistent calyx, cylindrical and very narrow; apex blunt.

The anthers burst as the flower expands when they are slightly above the stigma. In the open flower the anthers are above the stigma.

Type XLII. Resembles type XLI in every respect except as regards the leaves. These are smaller (average length 25 cms.; ratio length/breadth 2·3) with a smoother surface and fewer undulations, and are slightly darker than in type XLI. These differences, though slight, are quite distinct and are maintained from year to year.

TYPE XLI.

Type XLIII. Plants very early; height 112 cms. This type resembles types XLI and XLII very closely, but the plants are taller and the leaves larger and fewer in number. *Leaves* sessile, inserted at an angle of 60°, afterwards becoming horizontal, very slightly auriculate, amplexicaul, decurrent to a varying amount, the decurrent portion of the lamina very broad; shape elliptical, the lamina being very slightly narrowed towards the base; secondary veins arise at an angle of nearly 90°; apex acute; margin with occasional large undulations which are more frequent towards the base of the leaf; surface very slightly puckered; colour somewhat dark yellowish green; texture medium; average length of leaf 32 cms.; ratio length/breadth 2·2. *Inflorescence leaves* resemble the lower leaves in every respect, but are smaller. *Inflorescence* not conspicuous and not much raised with numerous side branches which surpass the main axis in height and are parallel to it. *Flowers* resemble those of type XLI in most respects, but the calyx is slightly longer and less globular and the indentations between the lobes of the corolla and also the apical points are more marked. *Capsule* larger than in type XLI and more pointed.

Pollination takes place in the same manner as in type XLI, but the anthers are raised further above the stigma.

TYPE XLIII.

Type XLIV. Plants somewhat early ; height 116 cms. ; similar in habit to types XLI and XLII, but taller and with larger leaves ; internodes moderately long, no leaves lie on the ground. *Leaves* sessile, inserted at an angle of 60°, but tend to become horizontal later, slightly auriculate, amplexicaul and decurrent, the decurrent portion of the lamina is very broad ; shape elliptical, lamina slightly narrowed towards the base ; secondary veins arise at an angle of nearly 90° ; apex obtuse ; margin with very occasional slight undulations ; surface flat ; colour dark yellowish green ; texture medium but thinner than in types XLI and XLII ; average length 32 cms. ; ratio length/breadth 2·2. *Inflorescence leaves* resemble the lower leaves in every respect, but are smaller. *Inflorescence* not conspicuous and not much raised with numerous side shoots which surpass the main axis in height and are parallel to it. *Flowers* pale pink in the bud, the expanded corolla being white ; length 44 mm. The flowers resemble those of type XLI, but the calyx is slightly longer and less globular. *Capsule* longer than the persistent calyx, conical ; apex somewhat pointed.

The anthers burst in the bud or just as the flower expands when they are slightly above or round the stigma. In the fully open flower they occupy the same position as regards the stigma which is generally covered with pollen.

TYPE XLIV.

PLATE LI.

Type XLV. Plants somewhat early, tall; height 137 cms.; internodes long; leaves large; the habit of the plants is not so bushy as in types XLI, XLII, XLIII and XLIV. *Leaves* sessile, inserted at an angle of 60°, but tend to become horizontal later, very slightly auriculate, amplexicaul, decurrent to a varying amount, the decurrent portion of the lamina very broad; shape elliptical, lamina slightly narrowed towards the base; secondary veins arise at an angle of nearly 90°; apex acute; margin with occasional very slight undulations; surface flat; colour light green; texture thin; average length of leaf 37 cms.; ratio length/breadth 2·2. *Inflorescence leaves* resemble the lower leaves in every respect, but are smaller. *Inflorescence* not conspicuous, not much raised; side branches fewer in number than in types XLI, XLII and XLIII, equal in length to the main axis and parallel to it. *Flowers* deep pink in the bud; pale pink or white in the expanded flower; length 50 mm. *Calyx* somewhat globular, less than half the length of the corolla; teeth short and obtuse. *Corolla* with an orifice 9 mm. in diameter, the transition between the tube and the dilated portion abrupt; limb quite entire. *Capsule* equal in length to the persistent calyx, conical; apex somewhat pointed.

The anthers burst in the bud when just above the stigma. In the open flower the burst anthers are decidedly above the stigma.

TYPE XLV.

Type XLVI. Plants somewhat early; height 126 cms.; internodes short; leaves very large, none borne on the ground. *Leaves* sessile, inserted at an angle of 45° to 60°, becoming horizontal or even bending downwards later, auriculate, amplexicaul, very decurrent (sometimes as much as 5 cms.), the decurrent portion of the lamina being broad; shape elliptical, the lamina decidedly narrowed in the basal fourth of the leaf; secondary veins arise at an angle of 60°; apex acute; margin with very slight undulations; surface flat; colour light green; texture thin; average length 52 cms.; ratio length/breadth 2·6. *Inflorescence leaves* like the lower leaves but smaller. Inflorescence inconspicuous, not much raised; side branches not very numerous. *Flowers* a very pale pink colour which rapidly fades to white; length about 44 mm. *Calyx* tubular and inflated, about half the length of the corolla; teeth moderately long and acute. *Corolla* with a broad tube; orifice of the corolla 9 mm. in diameter, the transition between the tube and the dilated portion gradual; limb entire, but with deep indentations between the lobes which bear short apical points. *Capsule* slightly longer than the persistent calyx, large, broad at the base, but tapering towards the apex which is blunt.

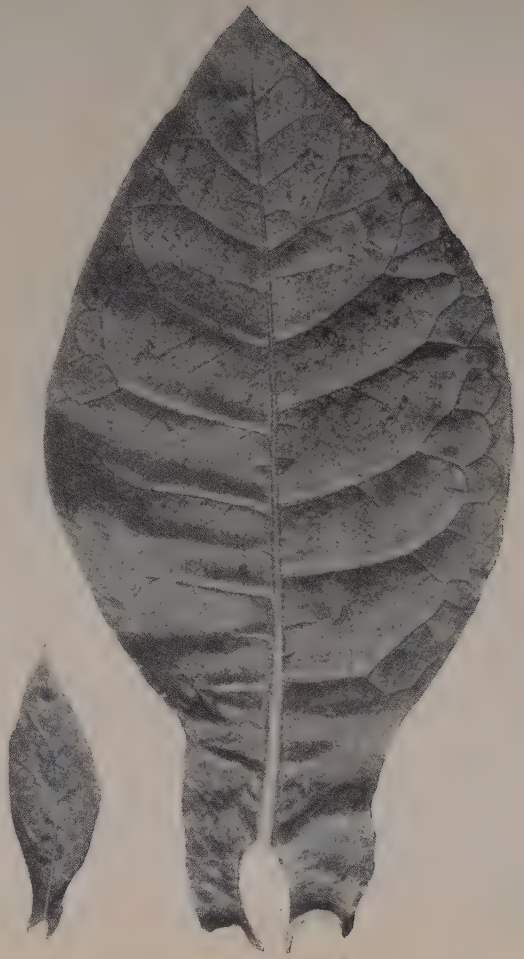
The anthers are at about the same level as the stigma and burst in the bud. In the fully open flower the anthers and stigma occupy the same relative positions and are level with the orifice of the corolla.

TYPE XLVI.

Type XLVII. Plants somewhat late, not very tall ; height 133 cms. ; internodes moderately long. Leaves borne at regular intervals up the stem, none on the ground. *Leaves* sessile, inserted at an angle of 90° and bend downwards at the tip, slightly auriculate, slightly amplexicaul, decurrent for 2·5 cms., the decurrent portion broad ; shape elliptical, lamina somewhat narrowed for a short distance above the base ; secondary veins arise at an angle of about 90° ; apex acute ; margin very slightly undulate, recurved ; surface slightly puffy or puckered ; colour somewhat light green ; texture medium to thick ; average length 42 cms. ; ratio length/breadth 1·9. *Inflorescence leaves* similar to the lower leaves but with more acute apices. *Inflorescence* more conspicuous and with more flowers than in types L and LI ; side branches level and parallel with the main axis. *Flowers* very pale pink in colour ; length 45 mm. *Calyx* less globular than in types L, LI and XLVIII, inflated, about one-third the length of the corolla ; teeth short and acute. *Corolla* with a wide orifice 10 mm. in diameter and an exceedingly broad tube, the transition between the tube and the dilated portion abrupt ; limb entire but indented and folded at the junctions between the lobes ; apical points very short. *Capsule* equal in length to the persistent calyx, conical ; apex pointed.

The anthers burst when just around or just above the stigma before the corolla expands. In the open flower the burst anthers are either just above the stigma or about 5 mm. above it ; in either case they are approximately level with the orifice of the corolla.

This type resembles type XLVIII in many respects such as habit, position of the leaves, etc. It differs, however, in some particulars such as the texture, colour of the leaves, and the indentation of the corolla lobes.



TYPE XLVII.

PLATE LI

Type XLVIII. Plants somewhat late ; height 114 cms. ; internodes moderately long. Leaves borne at regular intervals up the stem, none on the ground. *Leaves* sessile, inserted at an angle of 90° and bend downwards at the tip, slightly amplexicaul and auriculate, decurrent for about 5 cms., the decurrent portion broad ; shape elliptical, lamina somewhat narrowed above the base but for a lesser distance than in type LI ; secondary veins arise at an angle of about 90° ; apex acute ; margin very slightly undulate, recurved ; surface slightly puffy or puckered ; colour dark blue-green ; texture thin ; average length 38 cms. ; ratio length/breadth 1·9. *Inflorescence leaves* similar to the lower leaves, but apices more acute and base more undulate. *Inflorescence* more conspicuous ; flowers much more numerous than in type LI ; side branches spreading and shorter than the main axis. *Flowers* very pale pink in colour, long ; length about 50 mm. *Calyx* globular and inflated, less than one-third the length of the corolla ; teeth short and acute. *Corolla* with a wide orifice 10 mm. in diameter and a broad tube, the transition between the tube and the dilated portion very abrupt ; limb entire but somewhat deeply indented and folded at the junctions of the lobes ; apical points short. *Capsule* equal in length to the persistent calyx, conical ; apex pointed.

The anthers burst when just round or just above the stigma before the corolla expands. In the open flower the burst anthers are slightly above the stigma and are well below the orifice of the corolla.

TYPE XLVIII.

PLATE

Type XLIX. Plants somewhat late, tall ; height 160 cms. ; internodes long, leaves borne at regular intervals up the stem, none on the ground. The leaves are vertical, giving the plants a very characteristic appearance. *Leaves* sessile, inserted at an angle of 45° or less, auriculate, amplexicaul, decurrent for 7 cms., the decurrent portion is broad at the top and then suddenly becomes narrow ; shape elliptical, lamina only very slightly narrowed at the base ; secondary veins arise at an angle of about 90° ; apex acute ; margin very slightly undulate ; surface practically flat ; colour light green ; texture thin ; average length 49 cms. ; ratio length/breadth 2·0. *Inflorescence leaves* similar to the lower leaves, but with more acute apices. *Inflorescence* with few flowers, and few side branches which are borne at the top of the stem. *Flowers* very pale pink in colour, short (length 40 mm.). *Calyx* globular and inflated, about one-third the length of the corolla ; teeth short and somewhat obtuse. *Corolla* with a wide orifice (11 to 12 mm. in diameter) and a very broad tube, the transition between the tube and the dilated portion very abrupt ; limb entire but indented and slightly folded at the junction of the lobes ; apical points short. *Capsule* slightly longer than the persistent calyx, conical ; apex acute.

The anthers are late in shedding their pollen and only burst as the flower expands when they are approximately level with the stigma. The burst anthers and stigma retain their relative positions in the fully open flower and are level with the orifice of the corolla.

TYPE XLIX.

Type L. Plants somewhat late, tall; height 163 cms.; internodes long; leaves borne at regular intervals up the stem, none on the ground; inflorescence not very conspicuous. *Leaves* sessile, inserted at an angle of 45° but tend to become somewhat horizontal later, slightly amplexicaul, auriculate, decurrent for 5 cms. or more, the decurrent portion broad; shape elliptical, lamina somewhat narrowed in the basal third of the leaf; secondary veins arise at an angle of about 90°; apex acute; margin very slightly undulate and recurved; surface slightly puffy or puckered; colour bluish green, but not quite as dark as in type LI; texture thin; average length 42 cms.; ratio length/breadth 1·8. *Inflorescence leaves* similar to the lower leaves, but with more acute apices. *Inflorescence* with few flowers and few side branches. *Flowers* very pale pink in colour; length 45 mm. *Calyx* globular and inflated, less than one-third the length of the corolla; teeth short and acute. *Corolla* with a wide orifice 11 mm. in diameter and a very broad tube, the transition between the tube and the dilated portion very abrupt; limb entire but indented and somewhat folded at the junctions of the lobes; apical points very short. *Capsule* longer than the persistent calyx, conical; apex pointed.

In the bud, before the corolla expands, the anthers are found just above the stigma and burst while in this position before the bud opens. In the fully open flower the burst anthers are about 5 cms. above the stigma and project beyond the orifice of the corolla.

This type resembles very closely type LI, but differs from the latter in height and in the position and colour of its leaves, which are more vertical and less dark in colour. Types LI, L and XLVIII form a series in which the height diminishes and the position of the leaves becomes more horizontal.

TYPE L.

Type LI. Plants somewhat late, very tall ; height 178 cms. ; internodes long, leaves borne at regular intervals up the stem, none on the ground ; inflorescence not very conspicuous. *Leaves* sessile, inserted at an angle of 60°, slightly amplexicaul and auriculate, decurrent for 5 cms. or more, the decurrent portion broad ; shape elliptical, lamina somewhat narrowed in the basal third of the leaf ; secondary veins arise at an angle of about 90° ; apex acute ; margin very slightly undulate and recurved ; surface slightly puffy or puckered ; colour dark blue-green ; texture very thin ; average length 43 cms. ; ratio length/breadth 1·8. *Inflorescence leaves* similar to the lower leaves, but with more acute apices. *Inflorescence* with few flowers ; the side branches which are borne at the top of the stem are few in number and almost level with the main axis and parallel to it. *Flowers* very pale pink in colour, fading to white ; length about 45 mm. *Calyx* globular, inflated, less than one-third the length of the corolla ; teeth short and acute. *Corolla* with a wide orifice 11 mm. in diameter and a very broad tube, the transition between the tube and the dilated portion very abrupt ; limb entire but indented and somewhat folded at the junctions of the lobes ; apical points very short. *Capsule* longer than the persistent calyx, conical ; apex pointed.

In the bud before the corolla expands the anthers are found just above the stigma and burst while in this position before the bud opens. In the fully open flower the burst anthers are about 5 mm. above the stigma and project from the orifice of the corolla.

This type has an exceedingly good texture, the leaves are much thinner than in the ordinary Indian tobaccos. It has the great disadvantage, however, that the leaves are much exposed to the wind and do not protect each other as in the more bushy types. For this reason they are often badly torn before they ripen.

AGRICULTURAL RESEARCH INSTITUTE,
PUSA,
August 9th, 1909.